Bootstrap Seminar

A Comprehensive Strategy For Bootstrapping Organizations into the 21st Century

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BOOTSTRAP INSTITUTE
Bootstrapping Organizations into the 21st Century

A

BOOTSTRAP SEMINAR
Nov 30 - Dec 2, 1992

Foil Set A:

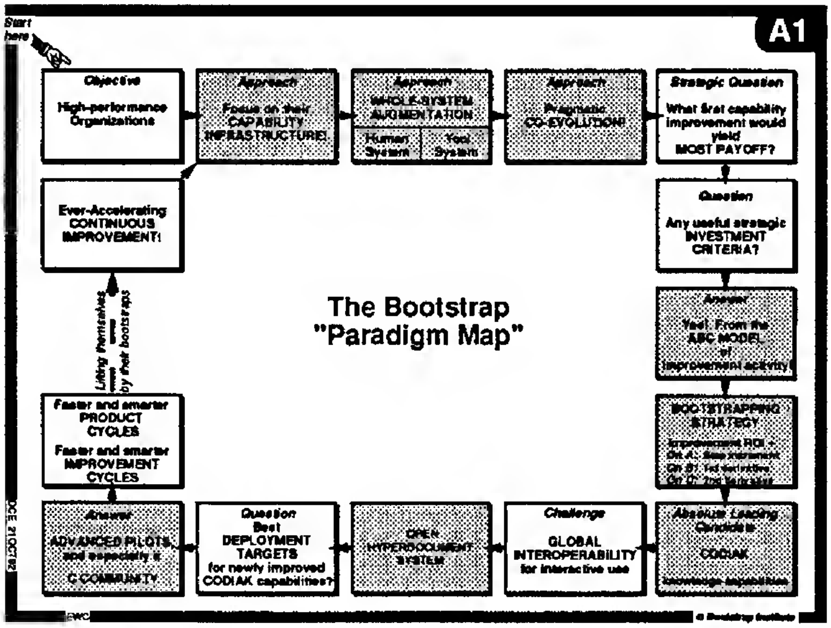
INTRO/SUMMARY

BOOTSTRAPPING ORGANIZATIONS
INTO THE 21ST CENTURY

Douglas C. Engelbart, Bootstrap Institute

Notes

A1



Notes

A2

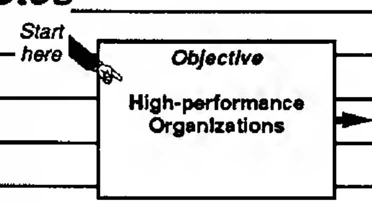
TOWARD A WINNING SURVIVAL STRATEGY

For an organization
to get better and better
at improving itself — to
accelerate toward a high-
performance organization.

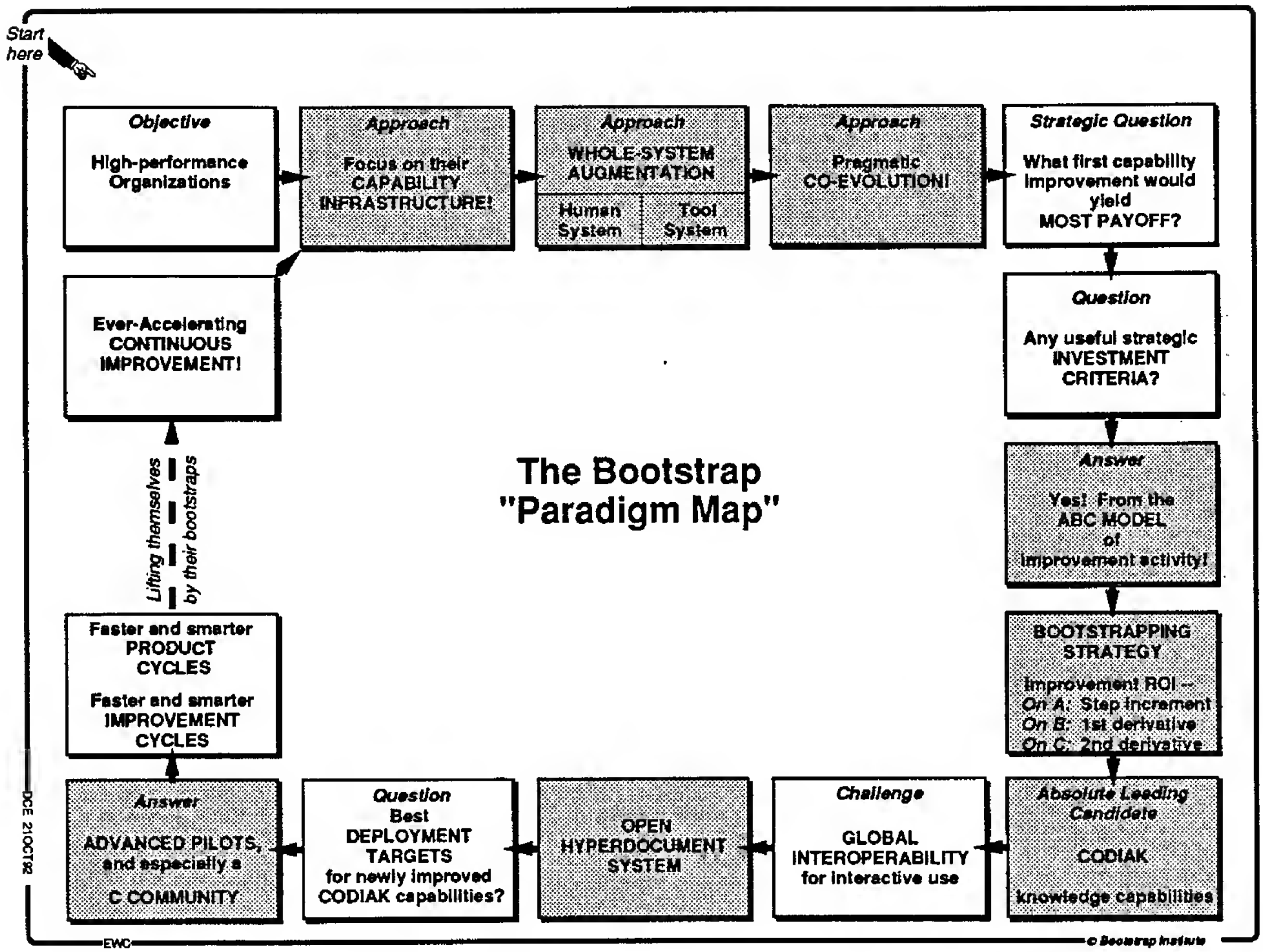
THIS IS THE CENTRAL THEME

OF THIS SEMINAR

Notes



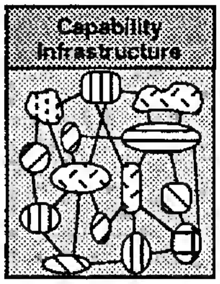
ENLARGEMENT OF A1



Notes

A3

OUR CAPABILITIES GROW – WITH HIGHER LEVELS DEPENDING ON LOWER LEVELS



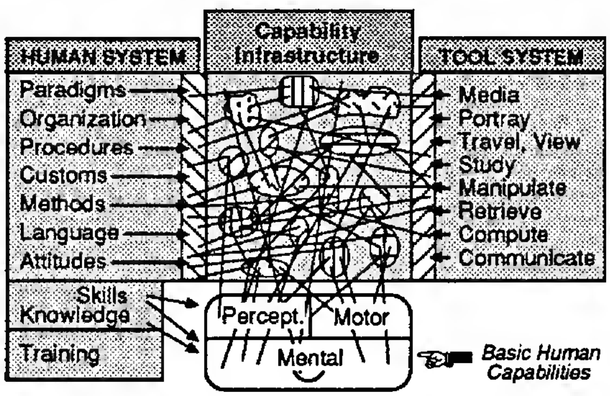
Notes

Approach

Focus on their CAPABILITY INFRASTRUCTURE!

A4

WHOLE-SYSTEM AUGMENTATION: MOST OF OUR CAPABILITIES ARE COMPOSITE



Notes

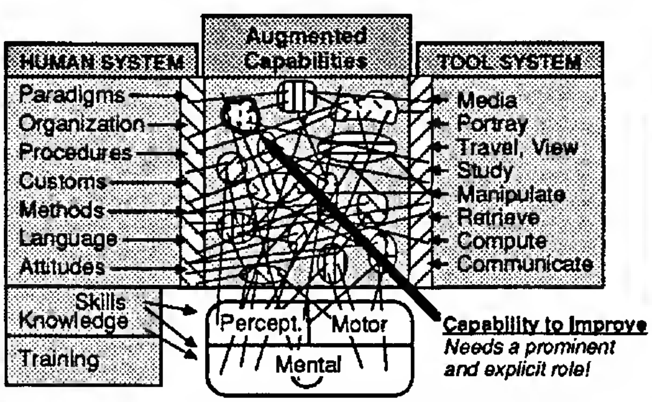
Approach

WHOLE-SYSTEM AUGMENTATION

Human System   Tool System

A5

CO-EVOLUTION OF HUMAN-TOOL SYSTEMS AS A CORE CAPABILITY TO IMPROVE



Notes

Approach

Pragmatic CO-EVOLUTION!

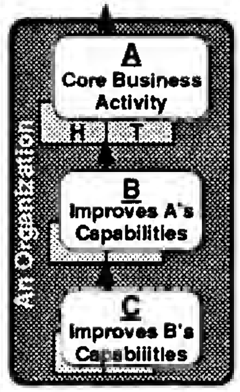
Notes

Answer

Yes! From the ABC MODEL of improvement activity!

A6

ABC's OF ORGANIZATIONAL IMPROVEMENT



A Activity:
Product R&D, mfg, marketing, sales, accounting, etc. Ex: aerospace -- producing planes; congress -- passing legislation; medicine -- AIDS research.

B Activity:
Improving the organization's ability to perform A work. Ex: introducing email or CAD systems; upgrading quality processes.

C Activity:
Improving the organization's ability to perform B work. Ex: introducing better ways to address needs, or run pilots.

How an organization explicitly improves its improvement capability.

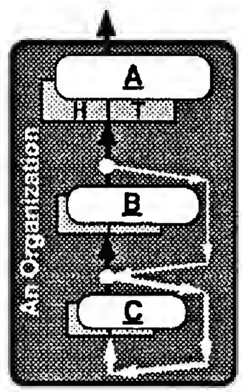
Notes

BOOTSTRAPPING STRATEGY

Improvement ROI --
On A: Step increment
On B: 1st derivative
On C: 2nd derivative

A7

EXTRA BOOTSTRAPPING LEVERAGE



Deploying improved capabilities to (also) improve the improvement processes.

Notes

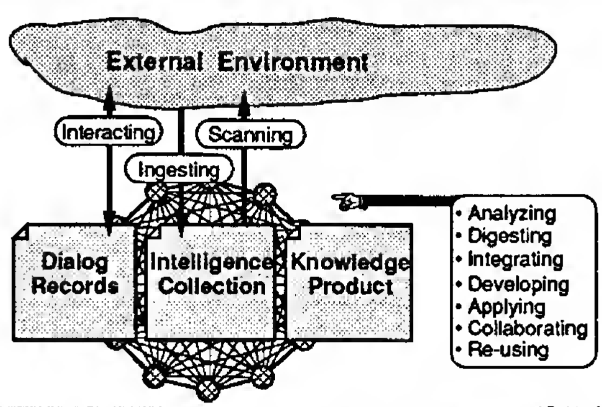
Absolute Leading Candidate

CODIAK

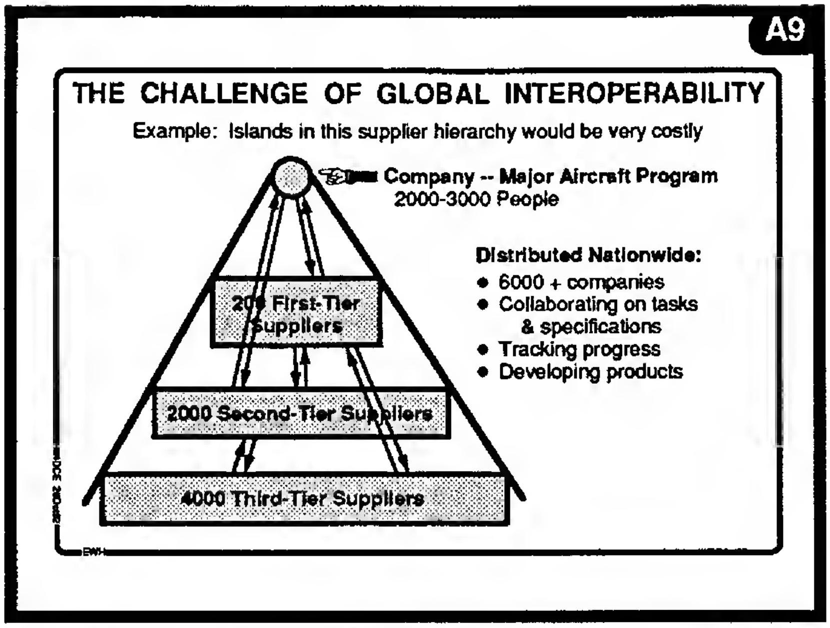
knowledge capabilities

A8

CODIAK: EVERY VIABLE ORGANIZATIONAL UNIT REQUIRES BASIC KNOWLEDGE PROCESSES



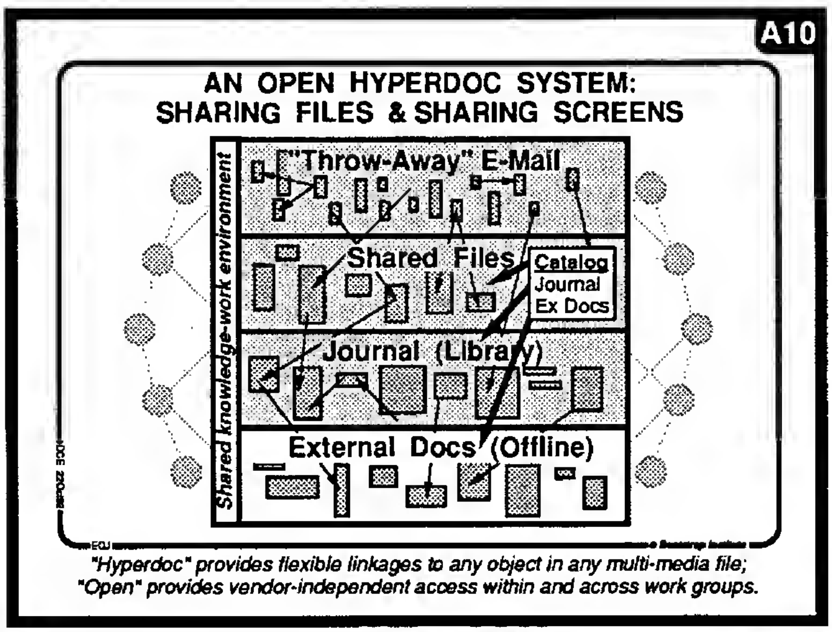
CODIAK: COncurrent Development, Integration, & Application of Knowledge.



Notes

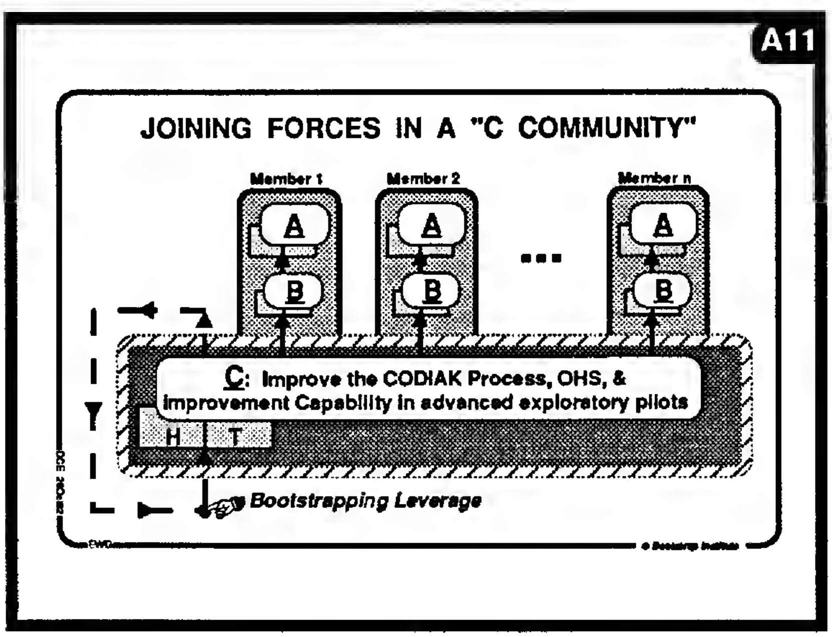
Challenge

GLOBAL INTEROPERABILITY for interactive use



Notes

OPEN HYPERDOCUMENT SYSTEM



Notes

Answer

ADVANCED PILOTS, and especially a C COMMUNITY

B

BOOTSTRAP SEMINAR
Nov 30 - Dec 2, 1992

Foil Set B:

PARADIGMS —

STRETCHING OUR PERCEPTIONS OF CHANGE

Douglas C. Engelbart, Bootstrap Institute

Notes

B1

BASIC BOOTSTRAP CONCEPTS

Objective: Pursue high-performance org
Hypothesis #1: Whole-system Augmentation
Hypothesis #2: ABC's of Org Improvement
Hypothesis #3: Bootstrap Strategy
Hypothesis #4: Collab. Knowledge Work (CODIAK)
Hypothesis #5: Open Hyperdoc System (OHS)
Hypothesis #6: Joining forces in a C Community

(assumes major paradigm shifts throughout)

Notes

B2

PARADIGMS

Envision sweeping change resulting from increasing complexity and urgency, and the many barriers to progress.

Envision "high-performance" organizations that maneuver through complexity and urgency with remarkable speed, agility, precision, and vision.

- Paradigms as Barriers to Change
- The Bootstrap Paradigm(s)
- Prevailing Paradigms Affect Strategy
- Shifting and Stretching our Paradigms
- Conclusion

Notes

Notes

B3

DEFINITIONS

Paradigm: a pattern, example, or model

Welt-an-schau-ung: ("world view") a comprehensive philosophy or conception of the universe and of human life.

Frame-work: 1. a structure serving to hold the parts of something together or to support something constructed or stretched over or aroune it (the ~ of a house). 2. the basic structure, arrangement, or system. 3. same as "frame of reference".

Frame of Reference: the set of ideas, facts, or circumstances within which something exists.

Notes

B4

PARADIGMS: EXAMPLES FROM HISTORY

Restrictive paradigms are easy to spot retroactively:

- Christopher Colombus on the "edge of the earth"
- Quoted reactions to innovation
- Doug's personal accounts

What are we doing *today* to amuse future historians?

Notes

B5

PARADIGMS & LANGUAGE

- **Language reflects world view**

  Example: Eskimos have 24 words for "snow"

- **Language shapes world view**

  Example: Words and concepts that can't be readily translated because there's no word for it

B6

PARADIGMS: CROSS-CULTURAL DIFFERENCES

- **Across cultures**

  Example: Shakespeare in the Bush -- a brief rendition was bombarded with comments about our "strange" customs

- **Across disciplines**

  Example: Analytics vs. Synthesizers
  Example: Strategists vs. tacticians

- **Across organizational units**

  Example: R&D vs. Legal vs. Manufacturing

Notes

B7

PARADIGMS & IMPROVEMENT PROGRAMS

- **Between improvOR and improvEE in the 3rd world**

  Example: Lack of appreciation for target culture resulted in complete rejection of new modern medical facility.

- **Between improvOR and improvEE within our organizations**

  ImprovORs: "Oh, those people will ***never*** be able to do that!"

  ImprovEEs: "Oh, corporate would ***never*** let us do that!"

Notes

B8

PARADIGMS & PLANNING

Planning tomorrow from today's paradigm?

If our paradigm consists of grass huts, we wouldn't get a 10-story building with an elevator, even though that technology were available.

Notes

Notes

B9

PARADIGMS

Envision sweeping change resulting from increasing complexity and urgency, and the many barriers to progress.

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- **Paradigms as Barriers to Change**
- **The Bootstrap Paradigm(s)**
- **Prevailing Paradigms Affect Strategy**
- **Shifting and Stretching our Paradigms**
- **Conclusion**

Since that time, the term "paradigm" has emerged to convey much the same meaning as the term "framework" used by Kennedy and Putt (1956) and Engelbart (1962, Bib-2, Bib-3). (You will find that we are using the terms "framework" and "paradigm" interchangeably.)

B10

PAPER BY KENNEDY & PUTT SPURRED THE 1960 "AUGMENTATION FRAMEWORK" SEARCH

They brought out the importance of a conceptual framework to the process of research.

They pointed out that new, multi-disciplinary research generally finds no appropriate framework to fit within; that a framework of sorts would grow eventually, but that an explicit framework-search phase preceding the research is much to be preferred.

Kennedy, J. L. and Putt, G. H., "Administration of Research in a Research Corporation," RAND Corporation Report P-847, April 20, 1956.

The rapidly increasing "complexity and urgency" will require correspondingly more rapid shifts in the paradigms within which we can effectively perceive and resolve our problems.

This is the challenge to humankind that triggered all of this Augmentation and Bootstrap pursuit.

B11

BOOTSTRAP'S BASIC PREMISE

"While population and gross product increase at a significant rate,

The complexity of man's problems grows still faster, and

The urgency with which solutions must be found becomes steadily greater ...

The product of complexity times urgency has surpassed man's ability to deal with it."

Paraphrased from '62 Augmentation Framework Paper

B12

EXAMPLE: COMPLEXITY & URGENCY FOR ORGANIZATIONS

Rapid and drastic changes in:

- Market forces
- Economic conditions
- Global competition
- Technologies
- Speed of change
- Social issues
- Environmental issues
- Legislative issues
- Etc.

How effectively is your organization responding?

Notes

B13

EXAMPLE: COMPLEXITY AND URGENCY COMPOUNDED BY NEW DIRECTIONS IN TECHNOLOGY

Automation → Augmentation
Creating nicer paper → Working in online environment
Personal computing → Groupware
Application islands → Integration
Departmental islands → Interoperability

- New directions in each area compound the complexity of assessment, experimentation, and assimilation in all areas.
- Rate and scale of technology "explosion" compounds the urgency.

Notes

B14

OUR EMERGENT TECHNOLOGY WILL PRODUCE VERY LARGE CHANGES IN OUR ORGANIZATIONS!

Compare a human organization to a crude biological organism: slow responses; poor sight; lousy perception; ponderously clumsy; doesn't understand its own workings; ...

A sudden mutation produces a new technology to support its nervous-system functions. Hugely better in all dimensions -- sensing, remembering, associating, perceiving, reasoning, coordinating, ...

Does the organism replace its old nervous system (i.e., automate), and there rest its future?

Or, does it set about evolving the rest of its structure and function to become a new, different, and much more capable organism?

DCE-AJJ4

Notes

The "quantitative scale" of these critical factors, when increased past a certain point, produce significant, qualitative systemic changes within our organizations and their environments.

Some domains of science and engineering long ago learned this about "dimensional scaling" within functional systems.

The qualitative changes are often a surprise to those who live with these systems every day.

It is thus predictable that surprising, large-impact changes will occur in our every-day environments.

Notes

Notes

B15

QUESTION OF SCALE AND PERVASIVENESS

What do different people believe will be the scale and pervasiveness of societal change stemming from computer-comunications technology? I.e., changes in the way:

- we live and work?
- our organizations are structured?
- our marketplaces are structured?
- our business transactions are negotiated and implemented?
- our legislative processes are carried out?
- our judicial systems work?
- our educational systems work?

B16

LARGE-SCALE TRANSFORMATIONS WILL BE COSTLY IN:

- **Dollars**
- **Human energy**
- **Stress**
- **Distraction from direct business functions**
- **Backing out from a wrong turn**

Expect decades of investment in change

B17

DESPERATELY NEED A GENERAL STRATEGY FOR SURVIVAL AND SUCCESS: *Faster & Smarter*

Faster: Increased Responsiveness

- Quick to identify the need for change
- Quick to integrate new knowledge
- Quick to make informed decisions
- Quick to respond to new market opportunities --
- Faster design, creation, delivery of quality products
- Quick to capitalize on new technologies & techniques
- Able to change course mid-stream

B18

DESPERATELY NEED A GENERAL STRATEGY FOR SURVIVAL AND SUCCESS: *Faster & Smarter*

Smarter:

- Ability to gather and analyze intelligence
- Data → meaningful information
- Creative, innovative
- Organizational memory and access
- Comprehend complexity
- Ability to see

Higher Quality:

- Improved coordination within and across work groups, and with suppliers and customers

DCE

Notes

B19

PARADIGMS

Envision sweeping change resulting from increasing complexity and urgency, and the many barriers to progress.

Envision "high-performance" organizations that maneuver through complexity and urgency with remarkable speed, agility, precision, and vision.

- **Paradigms as Barriers to Change**
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Notes

B20

What is *your* organization doing about all this?

Where will your strategy come from?

Notes

Notes

B21

ASSUMING HUGE CHANGES IN NEXT-CENTURY ORGANIZATIONS – HOW DO WE PURSUE THEM?

It is hard enough to cope with today -- with this quarter.

We've never before had to cope with change rates like this.

No models to guide us.

Notes

B22

CRITICAL CHOICE: WHICH EVOLUTIONARY PATH?

- Bewildering variety of paths will be perceived
- Expect extended period of rapid and complex change
- Organizations with better paths will emerge with improved capabilities
- Organizations with poorer paths will fall behind or die
- How will you and your competitors fare?

Notes

B23

CRITICAL NECESSITY: AN APPROPRIATE FRAMEWORK

- Not generally understood as an issue when opening new pursuits
- Inappropriate framework may lead to wasteful mistrials and widely ignored possibilities
- E.g., why wasn't computer-supported collaboration perceived as an important pursuit much sooner?
- Conceptual and strategic framework: Inherited from local culture OR consciously cultivated?

B24

BARRIERS TO THE DEVELOPMENT OF AN APPROPRIATE FRAMEWORK

- Limited perceptions of which changes are appropriate to pursue
- Limited perceptions of the scale of candidate change and of the potential payoffs
- Limited ROI time-frame for funding and careers
- Cultural inertia: "It's always worked this way"

Notes

B25

HOW DOES YOUR ORGANIZATION VIEW THE FUTURE?

Minor, gradual adjustments • OR • *Enormous, dramatic, sweeping changes*

- Your framework seriously affects your investment strategies
- An inadequate framework produces inadequate strategies
- Subtle difference in strategies will put some organizations far ahead of others in capability and effectiveness

Notes

B26

SERIOUS CONCERN

Today's organization seriously underestimates the rate, scale, and pervasiveness of change to come

Expect higher "fatality rate" of orgs the longer this persists

A first-world country, if not evolving effectively, could be in the 21st century's 3rd World

Notes

B27

Notes

HOW WILL YOUR ORGANIZATION DEVELOP ITS FRAMEWORK?

???

B28

Notes

HOW WILL YOUR INDUSTRY DEVELOP ITS FRAMEWORK?

???

B29

Notes

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B30

BOOTSTRAP FRAMEWORK DEVELOPMENT PRODUCED A STRATEGY

I have a strategy ... years of development and refinement resulted in detailed draft of a "handbook" with all the necessary ingredients for bootstrapping organizations into the 21st century.

Notes

B31

CHALLENGE

☞ Take this strategy, or one like it*, back to your organization and get going on it right away.

... but where would you take it? Who's responsible for it? Is your org positioned or even oriented for rapid, dramatic transformation?

The greatest limiting factor will be paradigms!

Your strategy needs to take this into account.

*If you have a better one, I'd really like to know so I can make mine better!

Notes

B32

BOOTSTRAP'S FRAMEWORK DEVELOPMENT PRODUCED A NUMBER OF PARADIGM SHIFTS

Stretching our perceptions of:

- Rate, scale and pervasiveness of change;
- Scale and nature of potential improvement in organizational capabilities -- significant concepts introduced that are difficult to discuss in today's vocabulary and paradigms. E.g.:
- Potential candidates for organizational change toward capability improvement;
- Strategic options for investing in improvement.

A critical issue -- if working effectively within tomorrow's organizations will involve a radical paradigm shift -- consider the special problem of trying to plan, design and implement tomorrow's Augmentation System from within today's paradigm.

See also note at C31.

Notes

B33

BOOTSTRAP PARADIGM BARRIERS

The Bootstrap Strategy is loaded with new paradigms!

- it is only recently that people are resonating
- not readily traslatable into today's paradigms
- broader in scope than most paradigms
- require paradigm shifts in several cross-disciplinary areas
- had to invent terms for discussing key concepts
- don't be surprised if you don't "get it" all on the first pass
- don't be surprised if you can't explain it easily to a colleague
- hope you'll agree Bootstrapping is important pursuit

Notes

B34

PARADIGMS

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Notes

B35

CONCLUSION

- We need higher-performance organizations *asap*
- Prevailing paradigms will *not* lead to serious pursuit soon enough
- We need a comprehensive strategy ***asap*** for bootstrapping organizations into the 21st century!

C

BOOTSTRAP SEMINAR
Nov 30 - Dec 2, 1992

Foil Set C:

AUGMENTATION THEORY —

CO-EVOLUTION OF HUMAN & TOOL SYSTEMS

Douglas C. Engelbart, Bootstrap Institute

Note that this section represents a portion of the "Conceptual Framework" published in Bib-2 (item 2 in bibliography), and condensed in Bib-3.

C1

BASIC BOOTSTRAP CONCEPTS

Objective:	Pursue high-performance org
Hypothesis #1:	Whole-system Augmentation
Hypothesis #2:	ABC's of Org Improvement
Hypothesis #3:	Bootstrap Strategy
Hypothesis #4:	Collab. Knowledge Work (CODIAK)
Hypothesis #5:	Open Hyperdoc System (OHS)
Hypothesis #6:	Joining forces in a C Community

(assumes major paradigm shifts throughout)

Notes

C2

Hypothesis #1: Whole-system Augmentation

Moving toward high performance organizations will require dramatic improvements in org capabilities.

Augmentation Theory provides a model for human-tool co-evolution of an org's capability infrastructure.

- **Basic Augmentation-System Model**
- **Prevailing Augmentation Practices**
- **Strategic Augmentation**
- **Conclusion**

Notes

Notes

C3

DEFINITIONS

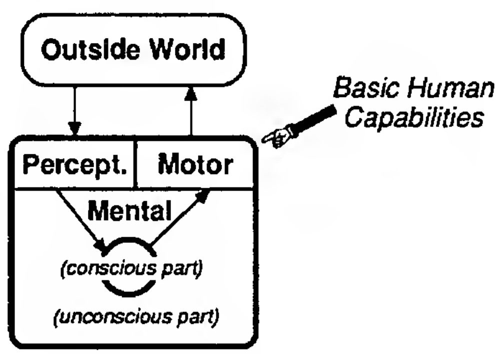
augment (Websters) to make greater, as in size, quantity, strength, etc.; enlarge.

augment (DCE) to boost our capability infrastructure through the explicit co-evolution of human and tool systems.

Notes

C4

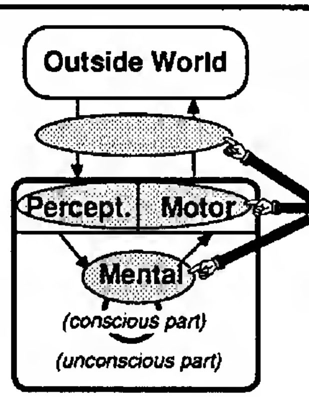
STARTING TO THINK ABOUT HIGH PERFORMANCE: BEGIN WITH BASICS



Any significant human capability utilizes an Augmentation System within which trained and conditioned "augmented humans" can exercise that capability.

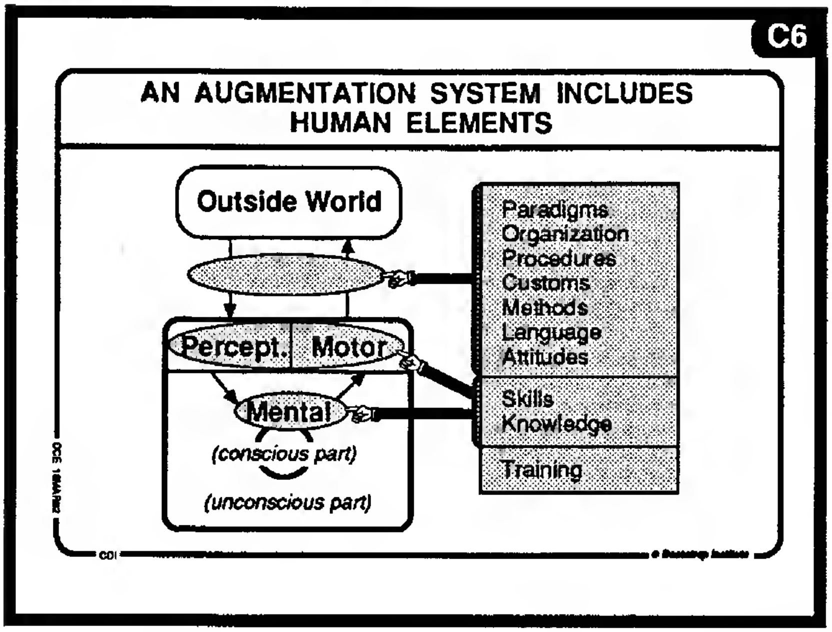
C5

BUT OUR BARE MENTAL-MOTOR PERCEPTUAL MACHINERY CAN'T DO MUCH BY ITSELF



How could human's tiny grasp cope with large tasks and problems?

Human societies had to *augment* our basic human capabilities by developing a complex system of language, customs, tools, and methods.



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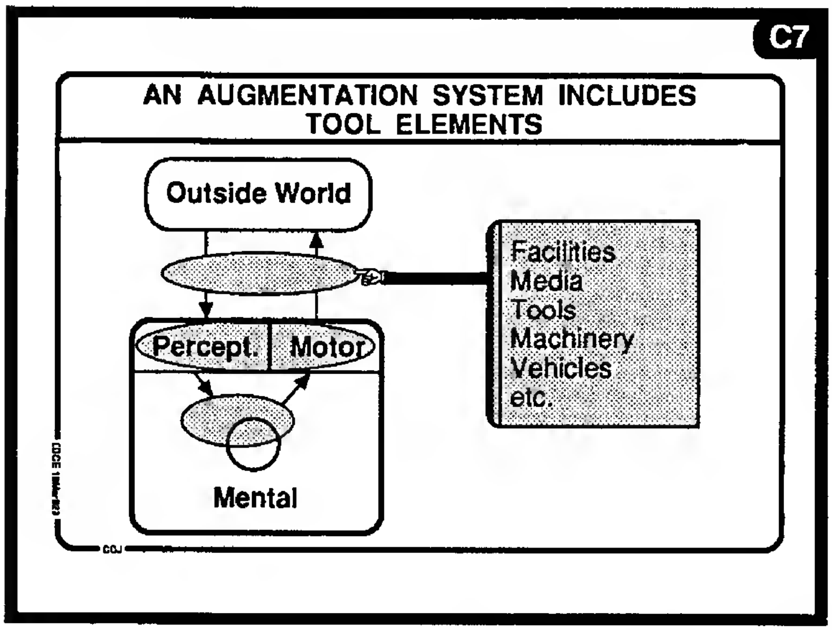

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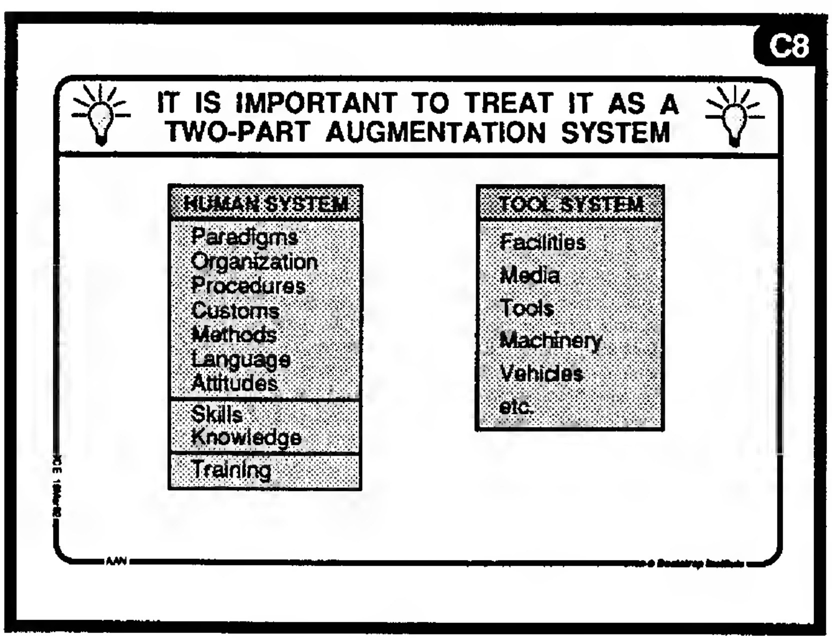


Notes

Notes

C9

EXAMPLE: CONSIDER A FAMILIAR AUGMENTATION SYSTEM

HUMAN SYSTEM	TOOL SYSTEM
Laws Regulations Insurance Licensing Rules of the road Traffic patrol "low riding"	Automobiles
Skills Knowledge	Roads, Bridges, Freeways, Toll Stations, Rotaries, Traffic lights, Stop signs, Spare tires, Jacks, Chains, Road maps, ...
Training	

The automotive transportation system

Notes

C10

EXAMPLE: AN AUGMENTATION SYSTEM FOR KNOWLEDGE WORK

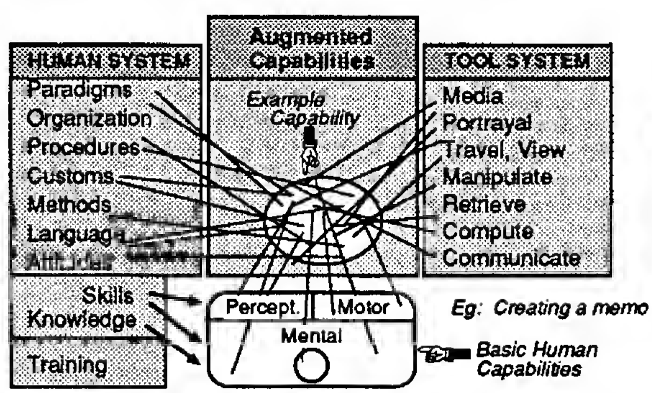
HUMAN SYSTEM	TOOL SYSTEM
File organization Managing email Fmt conventions Indexing Online footnotes "Bugs"&"Reboot" Intellect. p-rights	Media Portray Travel, View Study Manipulate Retrieve Compute Communicate
keybrd "mastery" Shared-file mgt	
Training	

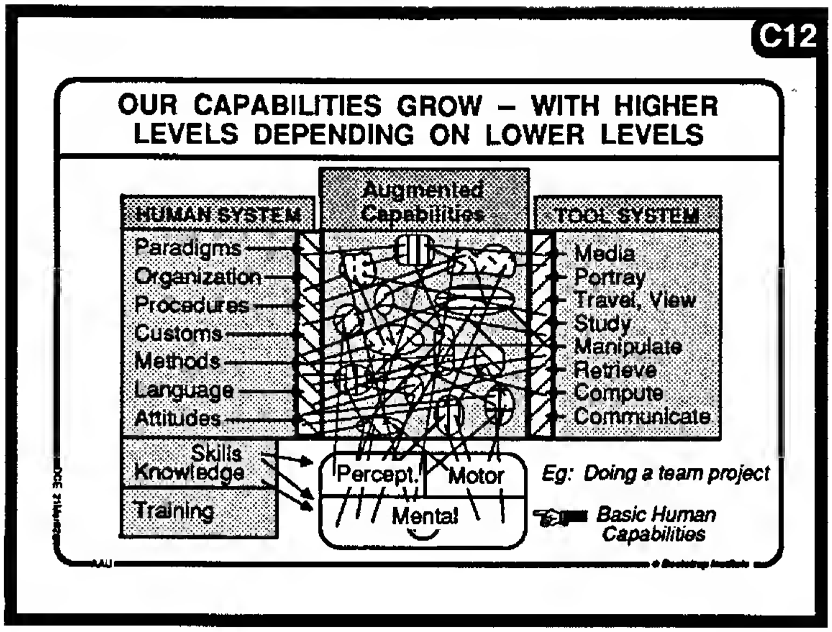
"Knowledge Workshop"

Notes

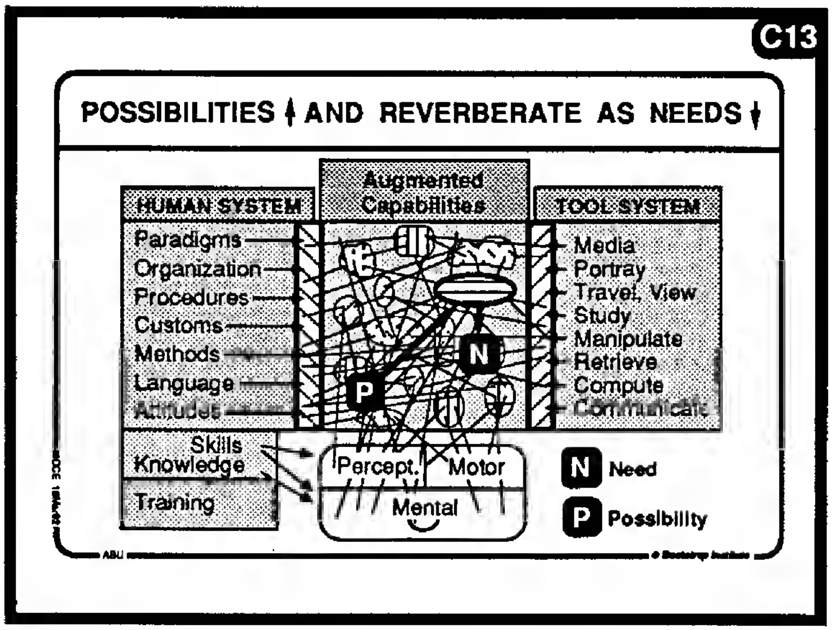
C11

MOST OF OUR CAPABILITIES ARE COMPOSITE

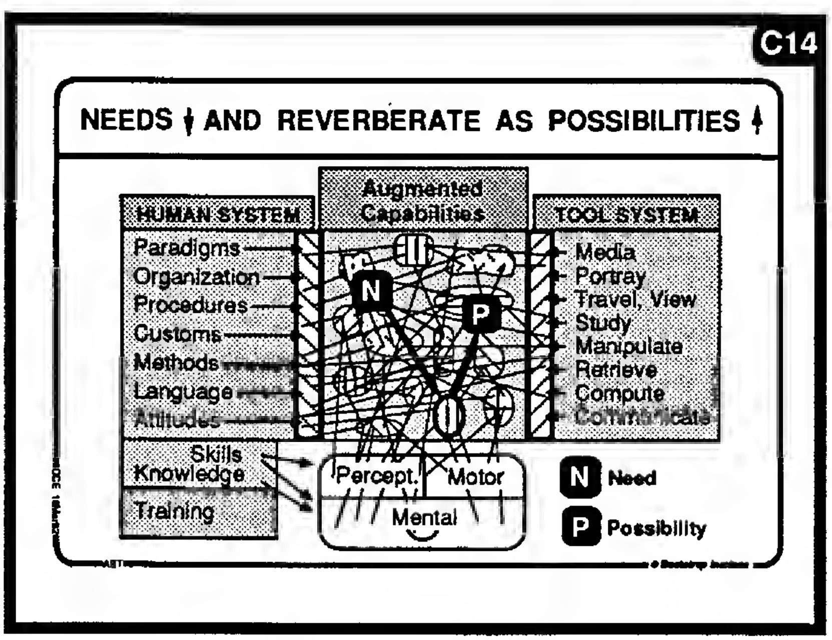




This model has been of seminal importance to the evolution of this "Bootstrap Strategy."



A "Possibility" for improvement of a higher level capability emerges when new or heretofore under-utilized, lower-level capability is seen to be available to harness -- but often requires other improvements in the lower levels -- developing a "Need."

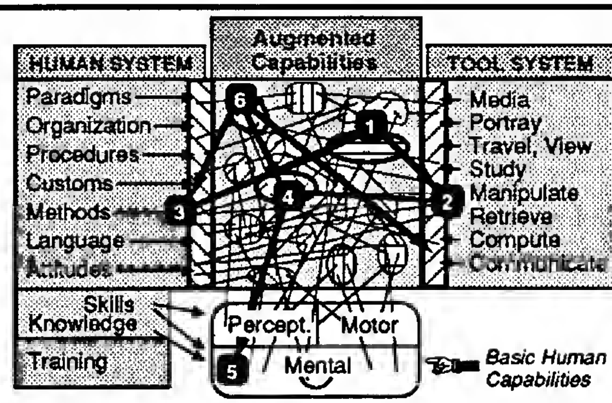


If a higher-level capability needs to be improved by harnessing some improvement which must be implemented in a lower-level -- then when that improvement is implemented, it provides a possibility for harnessing to improve other higher-level capabilities.

Realization about this reverberation of Needs ↓ and Possibilities ↑ as an Augmentation System evolves, when considered for the capability structure of a large organization, was instrumental in triggering the "Bootstrap" concepts in 1960-61.

C15

CO-EVOLUTION BY REVERBERATION



Notes________________

C16

CO-EVOLUTION BY REVERBERATION IS A NATURAL ORGANIC PROCESS

Until recently, our Augmentation Systems co-evolved gradually.

Selected elements changed in isolation, and the other elements eventually adapted ***on their own***.

Our Augmentation Systems remained largely intact, well-integrated, and coherent.

Notes________________

C17

THE TWO PARTS OF OUR AUGMENTATION SYSTEM GREW BY STEADY CO-EVOLUTION

For countless generations this has been a slow evolution, through processes such as:

- By the generational cycle of role succession
- By the five to ten-year cycle for students to be hired, integrated, and matured, and then to be listened to
- By the time it takes new findings to be published, digested, and then responded to

Further evolution will also necessarily be a ***concurrent*** process -- coordinated change in both the tool- and the human-system.

C18

Hypothesis #1: Whole-system Augmentation

Moving toward high performance will require dramatic improvements in organizational capabilities.

Augmentation Theory provides a model for faster and smarter improvement of an org's capability infrastructure.

- **Basic Augmentation-System Model**
- **Prevailing Augmentation Practices**
- **Strategic Augmentation**
- **Conclusion**

Notes

C19

* PARADIGM ALERT *

There is no name in the English language for *whole-system augmentation* or for *human system!*

And no discipline has emerged to provide integrated, whole-system approach. For example, "Augmentation System Architect."

Notes

C20

THERE IS A STRONG COUPLING BETWEEN AUGMENTATION SYSTEMS AND OUR CULTURE

One acquires most of his Augmentation System unconsciously, absorbed with little or no awareness during growth.

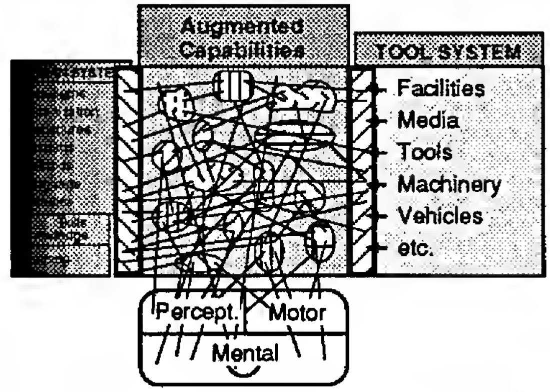
Thus, many fruitful possibilities in the Human System will simply not be recognized "naturally" as candidates for change.

Notes

Notes

C21

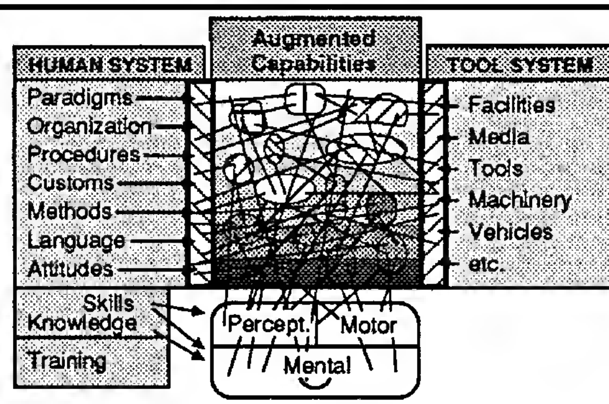
PREVAILING PARADIGM PLACES DISPROPORTIONATE FOCUS ON TOOL SYSTEM



Notes

C22

PREVAILING PARADIGM IGNORES MANY IMPROVEMENT OPPORTUNITIES



Notes

C23

PREVAILING PRACTICES COULD CRIPPLE OUR ORGANIZATION'S AUGMENTATION SYSTEM

- Not appreciating rate, scale, pervasiveness, and *complexity* of change
- Isolated changes, expecting the other elements to adapt "on their own"
- Paradigm "blind spots" skew selection of needs & possibilities
- Vendor-driven marketplace skews selection of needs & possibilities
- Computer revolution bombarding with point-solution technology
- Methods based on obsolete technologies
- Technologies based on obsolete methods
- Tools not harnessed for lack of well-developed methods
- Tactically-driven, with no strategy

C24

RESULT OF CURRENT TRENDS

- Augmentation Systems which are increasingly:
  - *un*balanced
  - *un*integrated
  - *in*coherent
  - fragmented
  - minimally applicable
  - minimally transferable

  i.e. "a fractured capability infrastructure"
- will prove very costly and wasteful!
- will probably ***not*** result in a high-performance organization!

Notes

C25

Hypothesis #1: Whole-system Augmentation

Moving toward high performance will require dramatic improvements in organizational capabilities.

Augmentation Theory provides a model for faster and smarter improvement of an org's capability infrastructure.

- **Basic Augmentation-System Model**
- **Prevailing Augmentation Practices**
- **Strategic Augmentation**
- **Conclusion**

Notes

C26

PARADIGM SHIFT

We can't just ***speed up***
today's "improvement" practices!

Notes

Notes

C27

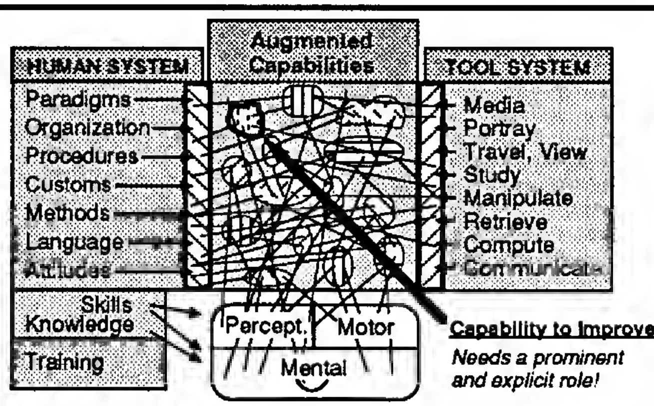
MOST OF THE FAMILIAR EVOLUTIONARY PROCESSES ARE GEARED FOR SLOW CHANGE

As the need for organizational change accelerates, we must find new processes by which changes are brought forth, assessed, accepted, and integrated into the whole -- processes which not only work within shorter time periods, but also within more complex and global organizational environments.

Notes

C28

CO-EVOLUTION IS A CAPABILITY THAT WARRANTS SERIOUS HIGH-LEVEL ATTENTION!



Notes

C29

NEW PARADIGM

Accelerating whole-system augmentation will require:

- New strategic criteria for investing in improved capabilities and for deploying newly emergent capabilities
- New recognition and prominence of capability-improvement roles and career paths
- Organizational units responsible for integrated whole-system pursuit
- More explicit co-evolution stages between R&D and end-use = special exploratory pilots
- New modes of collaboration in info-sys marketplace and among communities of improvement professionals

C30

NEW PARADIGM

We also need to get faster and smarter at:

- Identifying needs and possibilities
- Designing and deploying solutions
- Incorporating lessons learned

Toward improving the whole organization's *capability infrastructure!*

Notes

C31

PARADIGM REVISITED

The toughest part in acquiring a really new *effective* Augmentation System will be coping with the associated cultural evolution.

The prime limitation in how hard we pursue high-performance Augmentation Systems will be the perception of potential improvement -- which is essentially a cultural matter.

This suggests a critical hypotheses: The rate and direction of moving toward tomorrow's Augmentation System (and associated, changed culture) is limited by the perceptions inherent in today's culture!

C32

WE NEED A WHOLE-SYSTEM AUGMENTATION DISCIPLINE/APPROACH. *WHERE IS CAMP 3?*

Camp 1
- technology drivers
- automaters
- product developers and pushers
- etc.

Camp 2
- process drivers
- organizational development
- socio-technic
- etc.

Camp 3
Balanced co-evolution within integrated, whole- system environments?

Our Western culture has been quite tardy in developing the very under-populated Camp 3.

Notes

C33

Hypothesis #1: Whole-system Augmentation

Moving toward high performance will require dramatic improvements in organizational capabilities.

Augmentation Theory provides a model for faster and smarter improvement of an org's capability infrastructure.

- **Basic Augmentation-System Model**
- **Prevailing Augmentation Practices**
- **Strategic Augmentation**
- **Conclusion**

Notes

C34

CONCLUSION

- Co-evolution happens naturally by gradual reverberation
- Prevailing point-solution practices will probably *not* lead directly to high-performance capabilities
- Need strategy for faster and smarter co-evolution:
  - strategic selection of capabilities to improve
  - strategic deployment of early capability gains

Notes

D

BOOTSTRAP SEMINAR
Nov 30 - Dec 2, 1992

Foil Set D:

A-B-C's OF CONTINUOUS ORGANIZATIONAL IMPROVEMENT

Douglas C. Engelbart, Bootstrap Institute

Notes

D1

BASIC BOOTSTRAP CONCEPTS

Objective: Pursue high-performance org
Hypothesis #1: Whole-system Augmentation
Hypothesis #2: ABC's of Org Improvement
Hypothesis #3: Bootstrap Strategy
Hypothesis #4: Collab. Knowledge Work (CODIAK)
Hypothesis #5: Open Hyperdoc System (OHS)
Hypothesis #6: Joining forces in a C Community

(assumes major paradigm shifts throughout)

Notes

D2

Hypothesis #2: ABC's of Org Improvement

Moving toward high-performance organizations will require special ***organizational units*** responsible for rapid whole-system Augmentation.

- Basic ABC Model
- Prevailing ABC Practices
- Strategic ABC Practices
  - Bootstrapping Basics
  - C Communities
- Conclusion

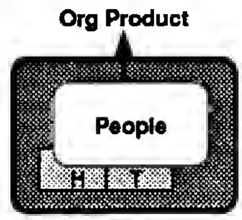
Notes

Notes

Notes

D3

ASSUMING HUGE CHANGES IN NEXT-CENTURY ORGANIZATIONS – HOW DO WE PURSUE THEM?

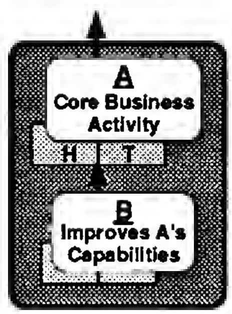


To move toward high-performance organizations:

- Needs high-priority, effective, strategically coherent approach.
- Assumes persistent high-level concern with improving ***total organizational capability*** (basic TQM principle).

D4

SIMPLE ORGANIZATION MODEL SHOWING EXPLICIT PROVISION FOR IMPROVEMENT



A Activity:
Product R&D, mfg, marketing, sales, accounting, etc. Ex: aerospace – producing planes; congress – passing legislation; medicine -- AIDS research.

B Activity:
Improving the organization's ability to perform A work. Ex: introducing email or CAD systems; upgrading quality processes.

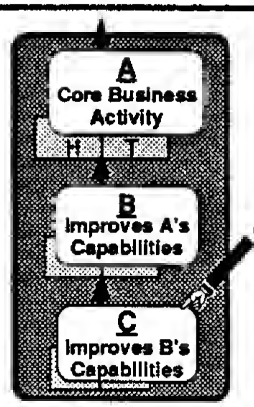
B should be a permanent "continuous improvement" activity (ala TQM)

This is where the "Bootstrap" element of our strategy begins to emerge. Watch how the opportunities to boost the B capability are opened up (to improve the capability to improve...).

And how about improving C's capability to improve B...?

D5

SIMPLE ORGANIZATION MODEL PROVIDING FOR IMPROVING THE IMPROVEMENT PROCESS

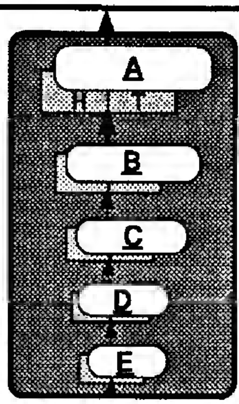


B capability is critical and warrants explicit improvement investment.

C Activity:
Improving the organization's ability to perform B work. Ex: introducing better ways to address needs, or run pilots.

D6

THEORETICALLY, THERE COULD BE AN ENDLESS SEQUENCE OF IMPROVEMENT ACTIVITIES



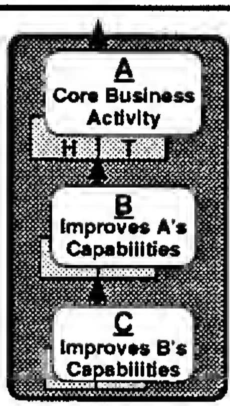
E.g.: a **D** that improves **C**, an **E** that improves **D**, etc.

For later models, yes! For now, since the activities of **D**, **E**, **F**, etc. are so similar to those of **C**, let's fold all of them into Activity **C**.

Notes

D7

HERE IS A USEFUL WAY TO CHARACTERIZE THE GOALS OF B AND C ACTIVITIES



B Work:
*Reduce **product-cycle** time -- to make faster, smarter, higher-quality **A** Activities*

C Work:
*Reduce **improvement-cycle** time -- to make faster, smarter, higher-quality **B** Activities*

This is of basic importance -- suggesting investing in a permanent C-Activity towards continuous improvement in B-Capability. (Within an effective investment strategy, of course.)

D8

SEMINAR GROUP DISCUSSION

Objective: Appreciating the **B** & **C** Acitvity

Tasks:

1. Develop list of representative **B** & **C** Activities
2. Develop list of capabilities which should be in B's Augmentation System; and in **C**'s.

Notes

Notes

D9

A COMMON GENERIC SET OF CAPABILITIES EMERGES FOR A, B, AND C

They all must:

- Identify needs and opportunities;
- Design and deploy solutions;
- Incorporate lessons learned.

All of which depends heavily upon the collaborative development of complex, integrated knowledge.

Notes

D10

Hypothesis #2: ABC's of Org Improvement

Moving toward high-performance organizations will require special ***organizational units*** responsible for rapid whole-system Augmentation.

- Basic ABC Model
- Prevailing ABC Practices
- Strategic ABC Practices
  - Bootstrapping Basics
  - C Communities
- Conclusion

Notes

D11

* PARADIGM ALERT *

There is no name in the English language for *C Activity!*

So we don't see many well-organized C Activities.

D12

OUR B ACTIVITY IS NOT AT PEAK PERFORMANCE

Common sayings among **A**'s when they spot a **B** Activity:

"Now what?!?"
or better still...
"RED ALERT! **B**'s sighted off starboard bow!"

Why? Ask any **A**:

- "**B** doesn't appreciate our operational environment"

Then ask **B**:

- "**A** doesn't want to change"

Notes

D13

B CAPABILITIES WARRANT SERIOUS ATTENTION

The current means of developing and integrating improvements are not adequate for the scale and rate of change faced today.

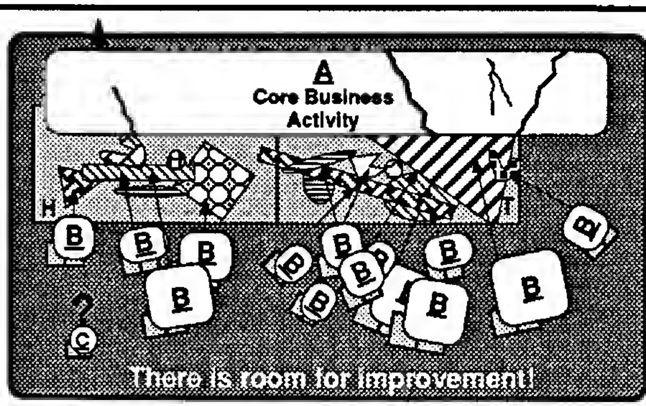
- assessing needs and possibilities
- surveying and evaluating options
- selecting, integrating, testing and applying
- identifying suitable pilot groups
- running and evaluating the pilots
- learning how much to introduce, how quickly
- how to overcome cultural barriers
- how to quickly incorporate lessons learned

Need more effective ways of introducing dramatic improvements into rapidly shifting organizational targets.

Notes

D14

OUR ORGANIZATIONS ACTUALLY LOOK MORE LIKE THIS



Notes

Notes

D15

SERIOUS CONCERN

- B Activities not positioned for whole-system augmentation
- B Activities not equipped for complex and rapid transfer
- B Activities scattered, ad hoc, loosely coordinated at best
- Result is *un*integrated, *in*coherent Augmentation System for A Activity
- Will probably *not* lead directly to high-performance organizations

Notes

D16

Hypothesis #2: ABC's of Org Improvement

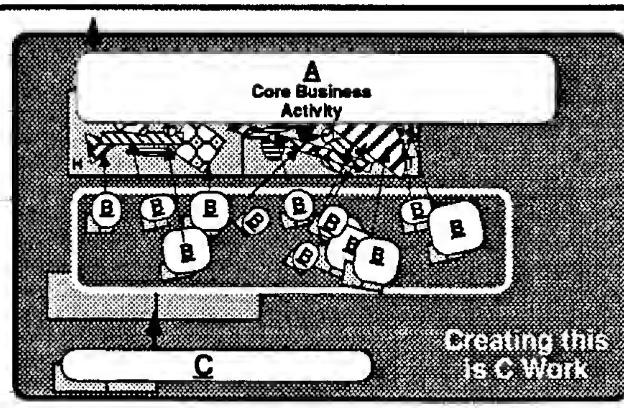
Moving toward high-performance organizations will require special ***organizational units*** responsible for rapid whole-system Augmentation.

- **Basic ABC Model**
- **Prevailing ABC Practices**
- **Strategic ABC Practices**
  - **Bootstrapping Basics**
  - **C Communities**
- **Conclusion**

Notes

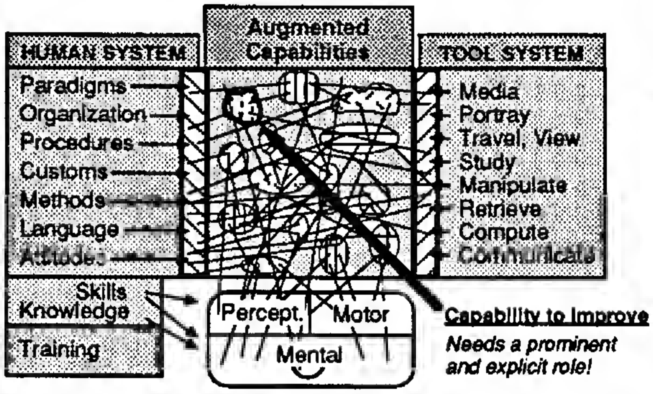
D17

* PARADIGM SHIFT * NEW MODEL FOR COHERENT B ACTIVITY



D18

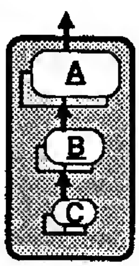
THE B ACTIVITY CAPABILITY WARRANTS SERIOUS ATTENTION!



Notes

D19

HERE ARE TWO IMPORTANT STRATEGIC ISSUES THAT SHOULD BE CONSIDERED:



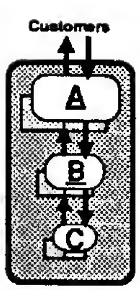
1. How to distribute the org's resources appropriately between **A, B & C.**
2. How to get highest **A**-improvement returns on investments in **B** and **C.**

Both issues are served by new capabilities that will have significant value within each of the three domains: **A, B & C.**

Notes

D20

BOOTSTRAPPING: STRATEGIC INVESTMENT CRITERIA



Selecting capabilities for **C** to improve that serve **A** and **C,** as well as **B**, offers special investment leverage. Start with these 3 most-basic capabilities:

1. doing group knowledge work;
2. transfer results "up the line" to respective "customers" (↑);
3. integrate information coming "down the line" from respective "customers" (↓).

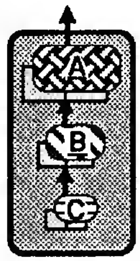
(note that capabilities 2 and 3 depend on 1)

Important -- note that improving these basic capabilities, and harnessing them in all 3 activities (i.e. A, B and C), will yield the compound returns in organizational improvement that characterizes the Bootstrap Strategy.

Notes

D21

THIS MODEL PROVIDES SOME STRATEGICALLY USEFUL OBSERVATIONS



Activity **A** involves a wide mix of activities, methods, and physical processes, including operational interactions with the outside world.

Activity **B** has a different mix: very people oriented and knowledge-work based; expert at knowing what improvements to make, and how to make them.

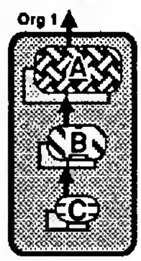
Activity **C** is much like B, but with smaller, more "mobile" client group; higher investment leverage.

Notes

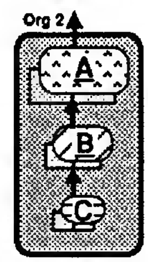
D22

HERE IS A PARTICULARLY USEFUL STRATEGIC OBSERVATION FROM THIS MODEL

How different, or similar, will the C-type activity be from org to org?



- Differences in **A** work will directly affect B-work *content*, but have much less affect on its *processes*.
- C-work focuses on improving B-work *processes*; less affected by B *content*.

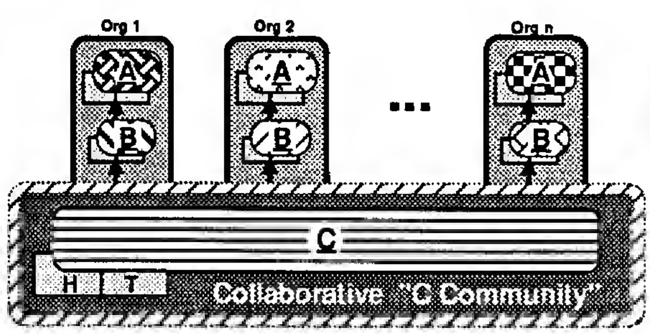


C Activities will have much in common from org to org -- *in both content and process.*

This C-Community concept wil be developed extensively in Foil Set J -- toward a proposed consortium, the Bootstrap Initiative. A draft plan for launching the Initiative is found in Section L.

D23

SIMILARITIES AMONG *C ACTIVITIES* OPENS STRATEGIC OPTION: COLLABORATIVE "C SUPPORT"



D24

THE *C COMMUNITY* PROMISES HIGH-LEVERAGE RETURNS ON IMPROVEMENT INVESTMENTS

- Shared investment yields much richer C-type support for each participating organization, at much less cost, than if it did its own C-work.
- Each organization can thus use more of its "improvement resources," together with this better C support, for improving its B and A capabilities.

Notes

D25

MORE C-COMMUNITY PAYOFF VIA RECURSIVE APPLICATION OF BOOTSTRAPPING

- Basically, any investment that improves the capabilities of both Activities A and B will provide this bootstrap leverage.
- But there is an even more dramatic bootstrapping possibility -- to focus on improving the effectiveness and quality of *C-Community* activities with improvements that are also highly useful within Activities A and B for all of the community's client organizations.

Notes

D26

Hypothesis #2: ABC's of Org Improvement

Moving toward high-performance organizations will require special ***organizational units*** responsible for rapid whole-system Augmentation.

- **Basic ABC Model**
- **Prevailing ABC Practices**
- **Strategic ABC Practices**
  - **Bootstrapping Basics**
  - **C Communities**
- **Conclusion**

Notes

Notes

D27

CONCLUSION

- Prevailing B practices will ***not*** lead directly to high-performance organizations.
- Orgs need an explicit C Activity to establish and support a *coherent* high-performance B Activity.
- For bootstrapping leverage C should first augment the *group knowledge work* capability -- a core competency in the org's capabilitiy infrastructure.
- Doing this improvement work within a C Community offers further, compounded leverage.

Notes

Notes

E

BOOTSTRAP SEMINAR
Nov 30 - Dec 2, 1992

Foil Set E:

THE CODIAK PROCESS —

KNOWLEDGE WORK AS A BASIC, STRATEGIC CAPABILITY

Douglas C. Engelbart, Bootstrap Institute

Notes

E1

BASIC BOOTSTRAP CONCEPTS

Objective: Pursue high-performance org
Hypothesis #1: Whole-system Augmentation
Hypothesis #2: ABC's of Org Improvement
Hypothesis #3: Bootstrap Strategy
Hypothesis #4: Collab. Knowledge Work (CODIAK)
Hypothesis #5: Open Hyperdoc System (OHS)
Hypothesis #6: Joining forces in a C Community

(assumes major paradigm shifts throughout)

Notes

E2

Hypothesis #4: Collab. Knowledge Work (CODIAK)

Early focus on improving a special collection of knowledge-work capabilities offers strategic investment leverage.

- Basic CODIAK Model
- Knowledge-Domain interoperability
- Common CODIAK Problems
- Strategic CODIAK Augmentation
- Conclusion

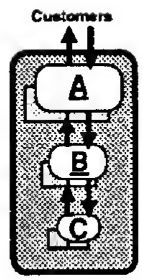
Notes

(Same as D20)

The CODIAK capability is a critical basic component underlying all three of these, strategically important capabilities.

E3

BOOTSTRAPPING: STRATEGIC INVESTMENT CRITERIA



Selecting capabilities for **C** to improve that serve **A** and **C**, as well as **B**, offers special investment leverage. Start with these 3 most-basic capabilities:

1. doing group knowledge work;
2. transfer results "up the line" to respective "customers" (↑);
3. integrate information coming "down the line" from respective "customers" (↓).

(note that capabilities 2 and 3 depend on 1)

Notes

E4

PROCESSES FOR "HEAVY KNOWLEDGE WORK" HAVE SPECIAL STRATEGIC IMPORTANCE

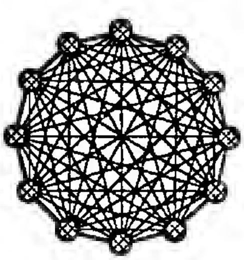
In this sense, the greater is the size, complexity, and urgency of a knowledge-intensive problem, the *"heavier"* is the knowledge work associated with developing a solution.

Strategic concepts in Augmentation Theory and Bootstrapping point to the fundamental importance of improving the core processes of heavy knowledge work.

Notes

E5

***BEGIN WITH BASICS:* PEOPLE WORKING TOGETHER IN AN ORGANIZATIONAL UNIT**



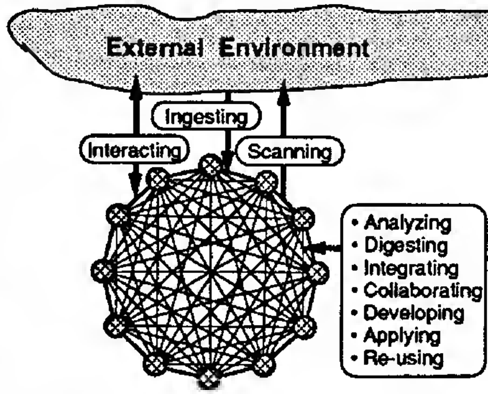
Examples of org units, or ***knowledge domains***:

- an individual
- project team
- department
- functional unit
- task force
- committee
- whole org
- community

Note: can be across-multiple organizations

E6

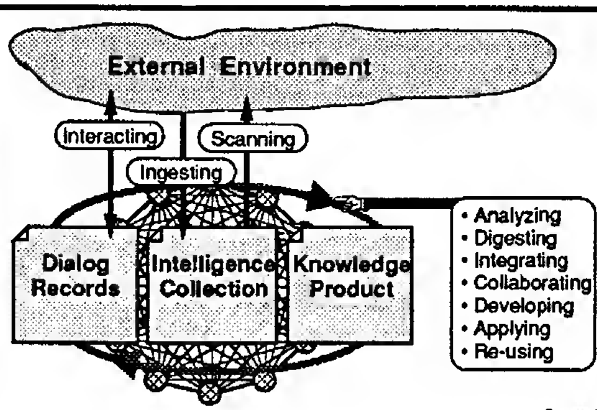
EVERY VIABLE ORGANIZATIONAL UNIT REQUIRES BASIC KNOWLEDGE PROCESSES



Notes

E7

BASIC KNOWLEDGE PROCESS RESULTS IN A DYNAMICALLY EVOLVING KNOWLEDGE BASE



Notes

E8

THIS EMERGES AS THE HIGHEST-LEVERAGE BASIC ORGANIZATIONAL CAPABILITY

The COncurrent Development, Integration, and Application of Knowledge ***(CODIAK)***

Developing an evolving knowledge base that integrates the concurrent contributions of many distributed participants, operating from the many (nested) knowledge domains involved within and among our enterprises, and concurrently supporting their application of the included knowledge.

Notes

Notes

E9

THE RESULTING KNOWLEDGE BASE REPRESENTS A VALUABLE *TANGIBLE* ASSET!

Dialog Records	External Intelligence	Knowledge Product
Memos	Articles, books	Proposals
Status reports	Reports, papers	Plans
Meeting minutes	Conf. proceedings	Budgets
Decision trails	Brochures	Legal contracts
Design rationale	Market surveys	Milestones
Change requests	Industry trends	Time lines
Commentary	Competition	Design specs
Lessons learned	Suppliers info	Product descriptions
Needs & Possib.	Customer info	Mfg plans
Bug reports	New technologies	Test plans & results
Field spt logs	New techniques	Field spt manuals
Design reviews	Trip Reports	Open Issues

Notes

E10

*** PARADIGM ALERT ***

The English language has no word for this *"knowledge product"*.

*I chose the term **"Handbook"** for this "baseline" project view.*

Knowledge Product / Current "Handbook"

- Proposals
- Plans
- Budgets
- Legal contracts
- Milestones
- Time lines
- Design specs
- Product descriptions
- Mfg plans
- Test plans & results
- Field spt manuals
- Open Issues

Below we use the model of a complex product-development project, in an industrial context, to illustrate the development of our CODIAK concepts.

Change the scale and substance, as for almost any complex pursuit, and the CODIAK picture will still emerge as a critical capability to augment.

("Handbook" -- the electronic embodiment of a knowledge product.)

E11

THE IDEAL HANDBOOK WOULD SHOW THE COMPLETE, CURRENT PROJECT STATUS

Goals, Plans, Designs, Budgets, Targets, Commitments, Schedules, Status, Staffing, Organization, Methods, Expectations, Specifications, Work Breakdown Structure, External Reference Data, ...

If kept constantly current and with visible relevance for all, a dynamic Handbook has central importance.

Storing intermediate Handbook states, and a record of the transitional dialog and reasoning, yields a critically valuable *organizational memory.*

E12

SEMINAR GROUP DISCUSSION

Objective:

Appreciating the value of intelligence collections

Task:

[To be determined]

Notes

E13

Hypothesis #4: Collab. Knowledge Work (CODIAK)

Early focus on improving a special collection of knowledge-work capabilities offers strategic investment leverage.

- **Basic CODIAK Model**
- **Knowledge-Domain interoperability**
- **Common CODIAK Problems**
- **Strategic CODIAK Augmentation**
- **Conclusion**

Notes

E14

A *KNOWLEDGE DOMAIN* IS AN ENVIRONMENT FOR A SPECIFIC KIND OF KNOWLEDGE WORK

A heavy-knowledge-work domain is made up of many levels of nested, concurrently active sub-domains.

Interoperability -- the dynamic, concurrent inter-change of dialog and knowledge products between these domains -- is a critically important factor in improving our capability for heavy knowledge work.

Where different of these nested domains are being seperately improved with inconsistent approaches, we're in danger of having domain-wall collisions instead of domain interoperability!

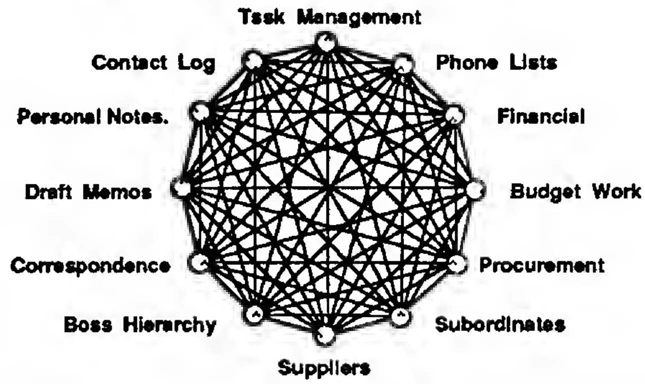
Notes

Notes

E15

EACH FUNCTIONAL DOMAIN IS A CANDIDATE FOR WORKING INTERCHANGE WITH ALL OTHERS

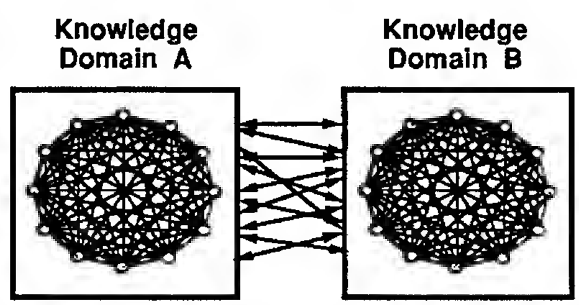
One Person's Knowledge Workshop



Notes

E16

CLOSE COOPERATION BETWEEN COMPOUND KNOWLEDGE DOMAINS PUTS NEW DEMANDS ON KNOWLEDGE-WORK INTERCHANGE



Notes

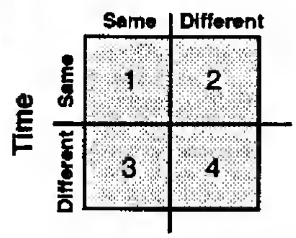
E17

ESSENTIAL GOAL: PROVIDE EFFECTIVE INTER-OPERABILITY BETWEEN KNOWLEDGE WORKERS

- The purpose of interoperability between technological modules is to avoid having information islands, between which electronic communications cannot flow.
- For humans, assume the same purpose -- interoperability to avoid having information islands between human knowledge-work domains.

E18

COLLABORATIVE PROCESSES GENERALLY CONSIDERED WITHIN FOUR SEPARATE DOMAINS



1. Face-to-face meetings.
2. Teleconferencing: video; audio; shared-screen.

3 & 4. Shared files, mail, document exchange.

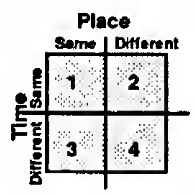
Complete interoperability between these domains is a basic requirement. (Not yet being addressed.)

Notes

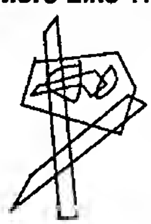
E19

ACTUALLY THE 1-2-3-4 DOMAINS ARE MERCILESSLY SCRAMBLED

Conventional Model of Group Work



Actual Topology More Like This

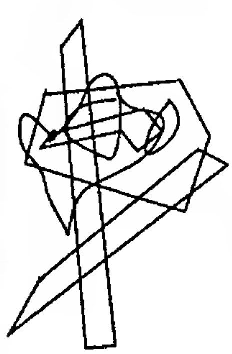


Different work domains (groups, functions) are concurrently interacting in each of the Place/Time modes.

Notes

E20

CONSIDER SOME KNOWLEDGE DOMAINS WITH WHICH YOU INTERSECT SIGNIFICANTLY



The old, paper-based operations adapted to the necessary interoperation.

Desktop publishing and WYSIWYG tools automate the paper equivalent ...

But to extend significantly into online access, study, and collaboration requires a great deal more interop coordination.

Here emerges the critical factor which shifts us into a new work and organization paradigm: harnessing our knowledge products in an online work mode. The concept of "document" as represented by typographically crafted pages (or frames, or cards) simply won't suffice, any more than did the "horseless carriage" concept.

Here we see the emergence of the "concurrency" factor; the development cycles of all these knowledge products (handbooks) are concurrently evolving, interdependently.

E21

HANDBOOKS USUALLY EVOLVE PIECEWISE VIA CYCLES WITHIN CYCLES

Larger projects are made up of smaller projects, which are made up of smaller projects, etc. -- finally to the smallest projects of each individual.

The activity records of most smaller projects warrant recording within their own "Handbook Sections."

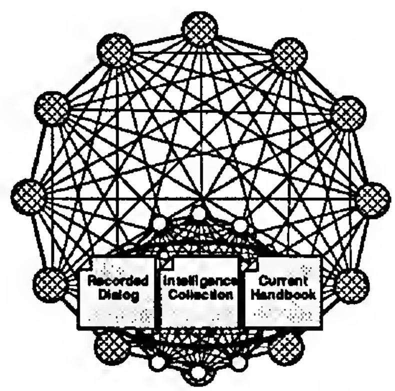
These Sections become modules subjected to dialog and coordination in the next-larger Handbook.

The over-all Handbook Cycle requires concurrent interoperation among the many domains doing these "Sub-Cycles" in the work breakdown structure.

Notes____________________

E22

ORG UNIT'S *CODIAK* PROCESS NESTED WITHIN OTHER ORG EFFORTS



Notes____________________

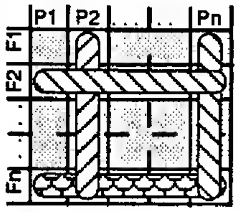
E23

CODIAK EXTENDS THROUGHOUT THE LIFE CYCLE OF A PROJECT TEAM

- Developed, integrated, and applied by many players over time.
- Handbook elements are under continuous and often concurrent revision.

E24

CONSIDER THE DOMAINS WITHIN A MATRIX ORGANIZATION OF PROJECTS AND FUNCTIONS



Each column, each row, and each intersection is an active knowledge domain.

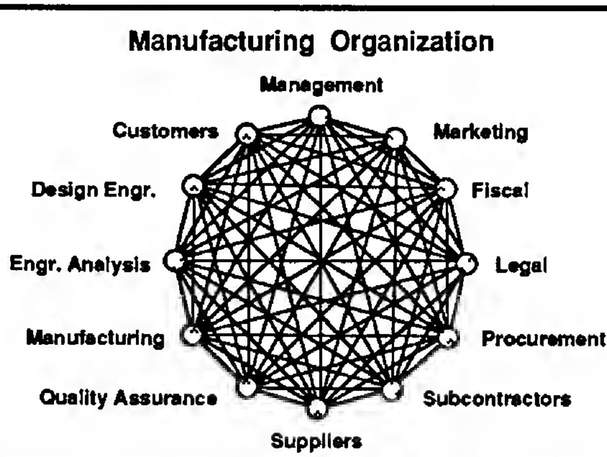
If the respective domains are not interoperable, then which is to prevail at intersections?

Actually, workers at such domain intersections will have to suffer with inter-domain switching and converting.

Notes

E25

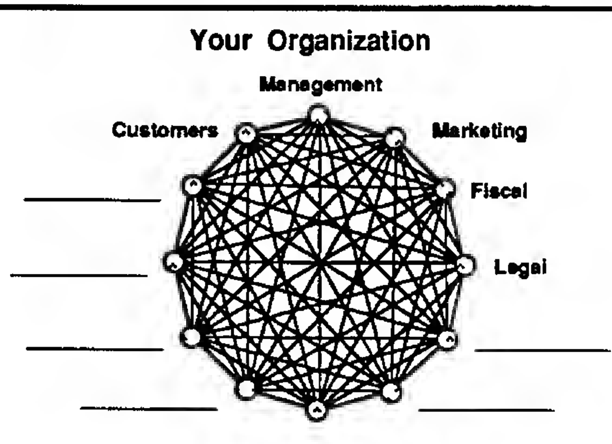
EACH FUNCTIONAL DOMAIN IS A CANDIDATE FOR WORKING INTERCHANGE WITH ALL OTHERS



Notes

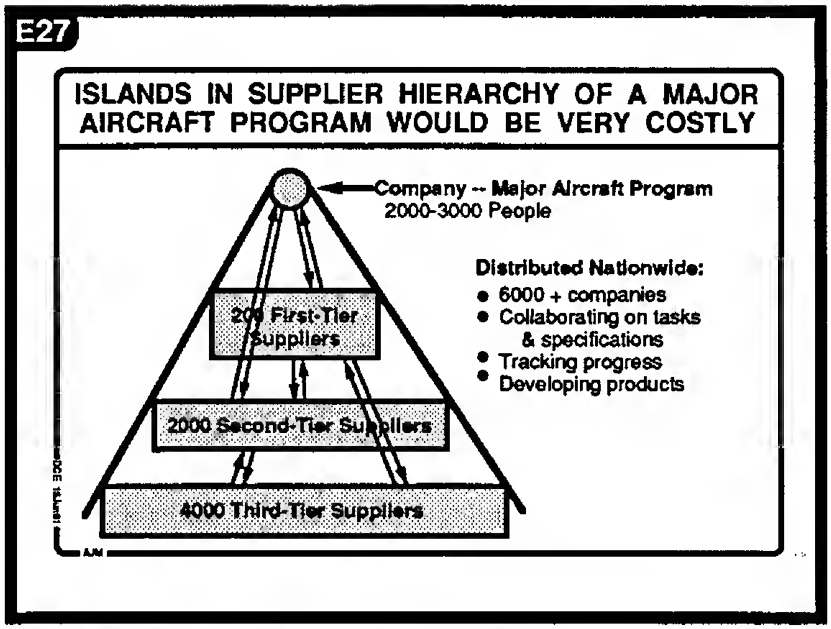
E26

EACH FUNCTIONAL DOMAIN IS A CANDIDATE FOR WORKING INTERCHANGE WITH ALL OTHERS

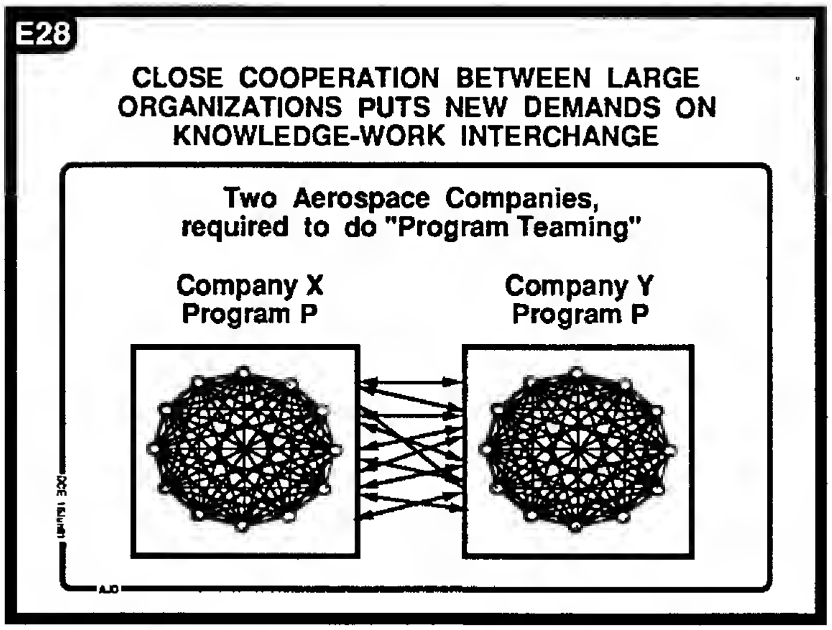


The most complex design, manufacture, and support challenge that we've contemplated -- for one of the planned new Air Force planes -- provides an interesting glimpse of the scale at which a future, high-performance CODIAK process will need to function.

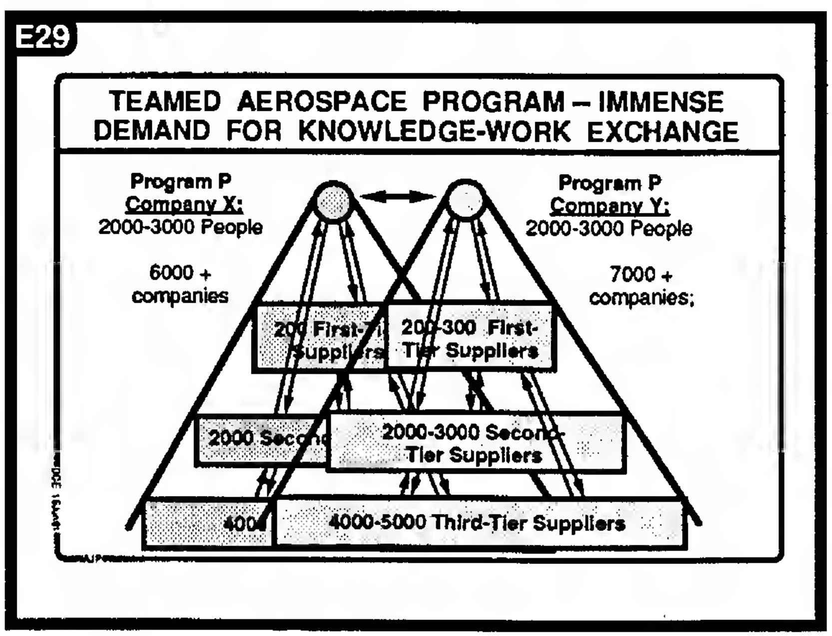
Notes



Heavy manufacturing industries have been active in exchange standards for CAD models, and Product Description data -- and also for electronic forms of conventional documents. But there is little appreciation (yet) for what the future, basic CODIAK processes will require.



Notes



E30

WITH INTERLINKED CUSTOMERS AND SUPPLIERS, NO MAJOR INDUSTRY CAN AFFORD ISLANDS

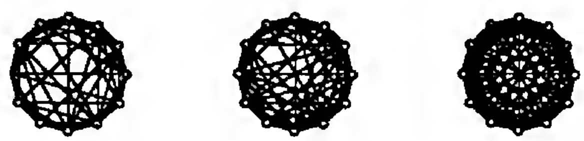
A whole industry, with many inter-operating organizational units, is in itself an "organization" that has a functional "augmentation system" whose improvement warrants explicit evolutionary attention.

The "A Activity" of this organization will very much need a global OHS. Early prototypical OHS capability for its C and then B Activities would thus be an immediate bootstrapping priority.

Notes

E31

PROVIDING FOR EXTENSIVE INTEROPERABILITY WILL BE EXPENSIVE



A **B** **C**

Yes, but -- how much more will Interoperability **B** cost than **A**? Or **C** than either?

Then compare the value of Interoperability **B** versus **A**; or, **C** versus either.

Notes

E32

Hypothesis #4: **Collab. Knowledge Work (CODIAK)**

Early focus on improving a special collection of knowledge-work capabilities offers strategic investment leverage.

- **Basic CODIAK Model**
- **Knowledge-Domain Interoperability**
- **Common CODIAK Problems**
- **Strategic CODIAK Augmentation**
- **Conclusion**

Notes

Notes

E33

COMMON PROBLEMS WITH PREVAILING PRACTICES

The CODIAK knowledge base represents a valuable corporate asset, but many of its crucial elements are generally *not* recorded.

Even minor inadequacies in the CODIAK process can be extremely costly:

- slip-ups in version control
- lapses in project "memory" (e.g. design intent)
- delayed access to critical intelligence
- non-optimal collaboration on design decisions

Notes

E34

SERIOUS CONCERN

More and more of our CODIAK work is done:

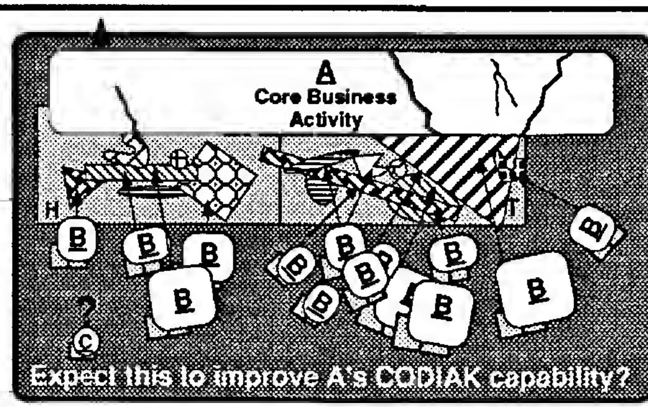
- concurrently
- online
- distributively
- using a *hodge-podge* of workstations, networks, applications, and utilities
- with point-solution software
- using poorly developed Human Systems

This could seriously undermine our whole CODIAK capability.

Notes

E35

B's WITH NO COHERENT SHARED *CODIAK*, NO STRATEGIC INTEGRATION, AND NO SUPPORT



E36

Hypothesis #4: Collab. Knowledge Work (CODIAK)

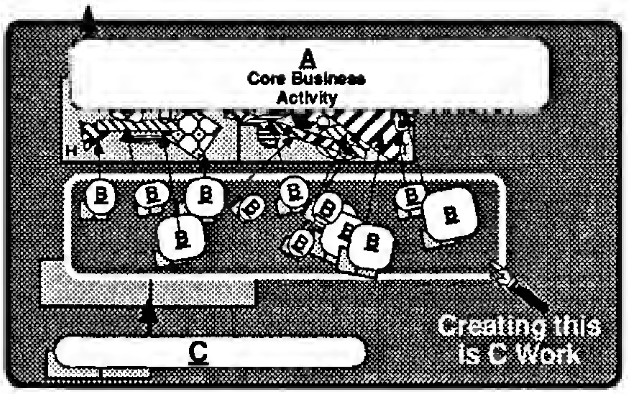
Early focus on improving a special collection of knowledge-work capabilities offers strategic investment leverage.

- **Basic CODIAK Model**
- **Knowledge-Domain Interoperability**
- **Common CODIAK Problems**
- **Strategic CODIAK Augmentation**
- **Conclusion**

Notes

E37

C PROVIDES COHERENT KNOWLEDGE BASE TO SUPPORT MORE EFFECTIVE, INTEGRATED B



Notes

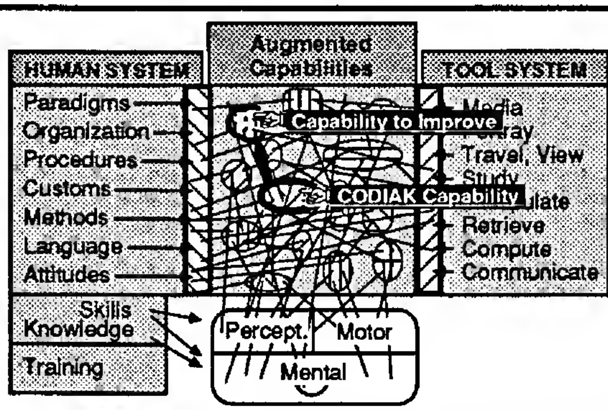
To produce a really significant improvement, a B-Activity must design and implement operational dynamics requiring many changes in skills, roles, methods, tools, facilities, working relationships, team discipline, performance metrics, knowledge configurations, etc.

Consider the many different stakeholders, disciplines, sub-projects and knowledge domains involved in the B-Work of designing and implementing such a large-capability improvement. There is fully as much need here for improved CODIAK capability as for a complex A-Work task (e.g. a product cycle).

This is why improving the basic CODIAK capability can be such a high-leverage investment.

E38

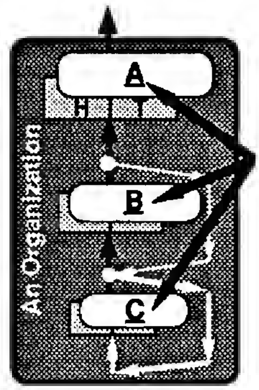
CODIAK IS A CORE CAPABILITY ON WHICH MANY HIGH-LEVEL CAPABILITIES DEPEND!



Notes

E39

AUGMENTING THE CODIAK PROCESS OFFERS EXTRA BOOTSTRAPPING LEVERAGE



This is the most *direct path* toward high-performance organizations!

Well-enhanced CODIAK means faster and smarter capabilities for:

- Identifying needs and possibilities
- Designing and deploying solutions
- Incorporating lessons learned

Improving the *product cycle* and the *improvement cycle* offers special compounded leverage!

Notes

E40

Hypothesis #4: Collab. Knowledge Work (CODIAK)

Early focus on improving a special collection of knowledge-work capabilities offers strategic investment leverage.

- **Basic CODIAK Model**
- **Knowledge-Domain interoperability**
- **Common CODIAK Problems**
- **Strategic CODIAK Augmentation**
- **Conclusion**

Notes

E41

HIGH-LEVERAGE STRATEGIC INVESTMENT: IMPROVING THE BASIC CODIAK CAPABILITY

Warrants early C-Activity focus:

- other higher-level capabilities depend heavily on CODIAK
- CODIAK is important capability for A, B, *and* C work
- CODIAK is basic foundation for many B products

Need an ***Augmented Knowledge Workshop:***

- well-integrated tools and methods
- bridging across computer systems, organizational units, time, and space.

Later will discuss details of how to make this happen.

F

BOOTSTRAP SEMINAR
Nov 30 - Dec 2, 1992

Foil Set F:

HYPERDOCUMENT SYSTEM —

A TOOL SYSTEM FOR CODIAK SUPPORT

Douglas C. Engelbart, Bootstrap Institute

See Bib-26 and Bib-28 in Section S and U for a more complete treatment of the "OHS proposal."

The answer to basic CODIAK interoperability is a future "Open Hyperdocument System."

F1

BASIC BOOTSTRAP CONCEPTS

Objective:	Pursue high-performance org
Hypothesis #1:	Whole-system Augmentation
Hypothesis #2:	ABC's of Org Improvement
Hypothesis #3:	Bootstrap Strategy
Hypothesis #4:	Collab. Knowledge Work (CODIAK)
Hypothesis #5:	Open Hyperdoc System (OHS)
Hypothesis #6:	Joining forces in a C Community

(assumes major paradigm shifts throughout)

Notes

F2

BRIEF NOTE ABOUT NLS/AUGMENT

Launched the R&D in early 60's for research prototype oNLine System (NLS) to support CODIAK work (then called Intellectual Work, later Knowledge Work).

Later bought by Tymshare, then McDonnell Douglas, where it got heavy use in pilot trials in aerospace and government, and renamed AUGMENT -- but no significant enhancement since early 80's.

The following requirements are based on extensive experience with these pilots.

AUGMENT badly needs replacing -- until then it is still useful for demonstrating the integrated features.

Notes

Notes

F3

Hypothesis #5: Open Hyperdoc System (OHS)

An underlying open hyperdocument-system infrastructure is needed to support interoperable, high-performance CODIAK work.

- Requirements for a Hyperdocument System
  - General Provisions
  - Recorded Dialog
  - Intelligence Collection
  - Electronic Handbook
- Toward *Open* Hyperdocument Systems
- Issues for the Info-Sys Marketplace

Notes

F4

A HYPERDOCUMENT SYSTEM FOR CODIAK SUPPORT

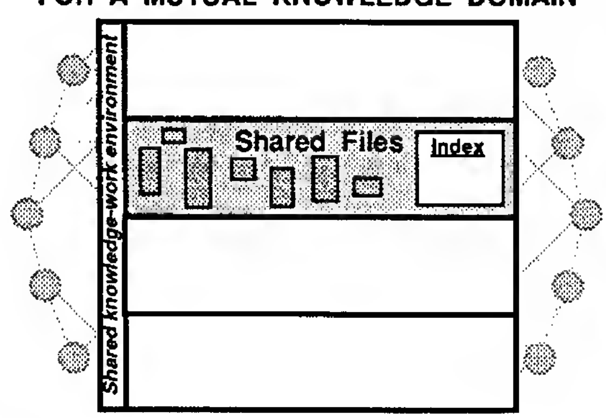
First beachhead for *online* CODIAK support:

Providing flexible linkages to any object within and across multi-media files.

Notes

F5

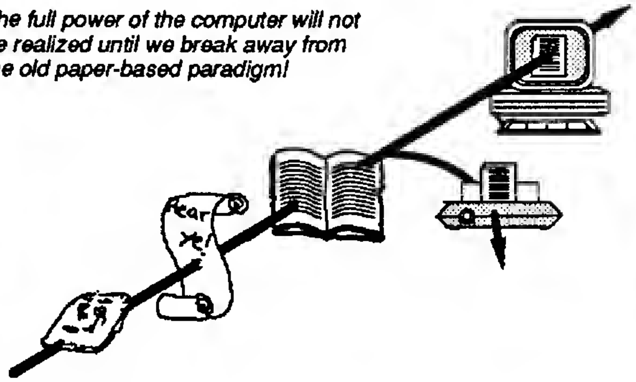
STAGE 1: SUPPORTING THE CODIAK PROCESS FOR A MUTUAL KNOWLEDGE DOMAIN



F6

PARADIGM SHIFT

The full power of the computer will not be realized until we break away from the old paper-based paradigm!



Notes

F7

* NEW PARADIGM * FROM AUTOMATION TO AUGMENTATION

Consider an alternative to just making nicer printouts --

composing, studying, modifying and communicating *online*.

A different paradigm from automated paper generation.

Notes

F8

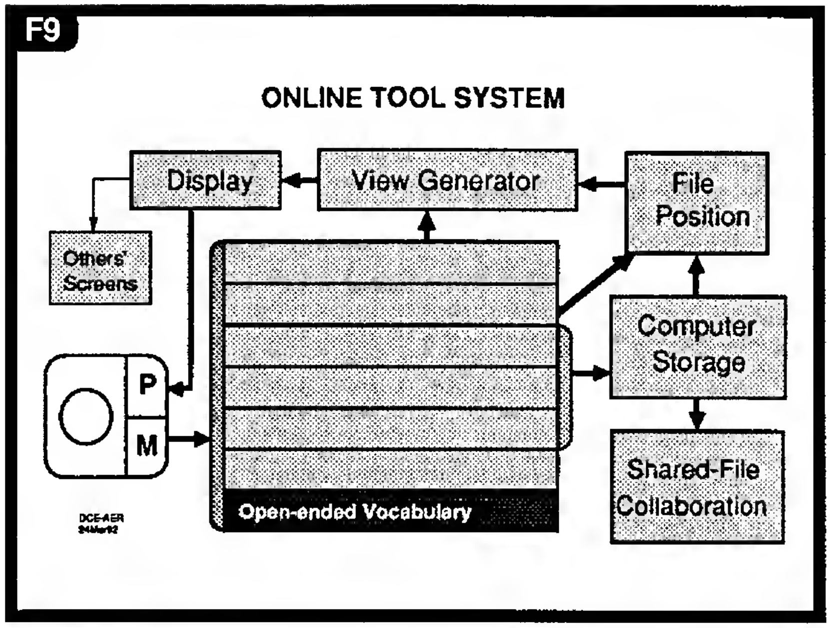
PARADIGM SHIFT

If you're just visiting Paris, you can get by with grunts and gestures, but if you *live* there you'll want the power of a fluent *language*.

What about providing an extensible command language as an extension of menus and function keys!

Notes

Providing for open-ended vocabulary growth -- in classes of objects (nouns) and executable functions (verbs) -- has been important to us from the beginning. See the "CLI" and Grammer elements in the architecture depicted in Foils G19 and G20; also the descriptions in Bib-20, Section O.



Notes

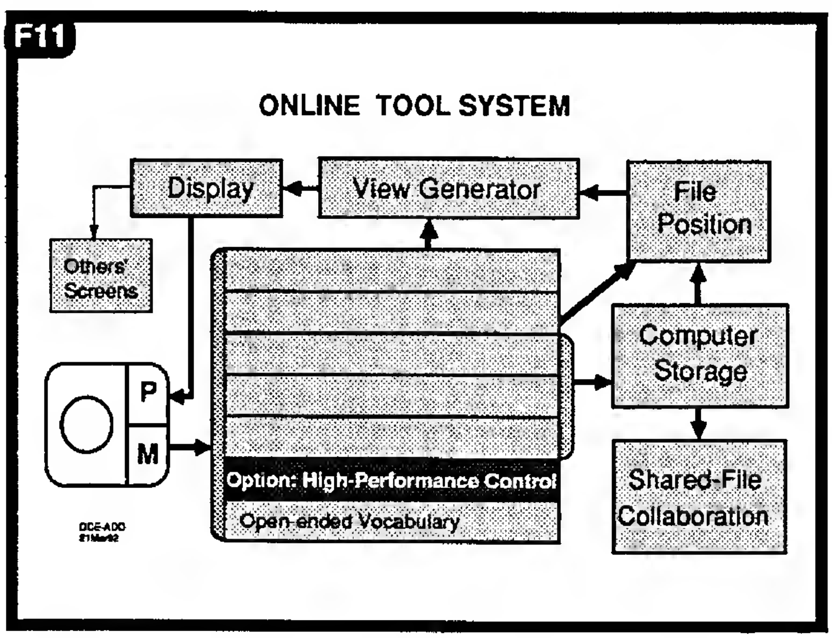
F10

PARADIGM SHIFT

Consider that future high-performance organizations *might* be populated with highly proficient knowledge workers!

What about providing optional high-performance controls for operating the high-performance hyperdoc-sys "vehicle"!

All of the foregoing flexiblity, designed for use over the full spectrum of knowledge-work activity, deserves a fast and flexible means of control.



F12

PUBLIC STATEMENT, 1963:
ABOUT FUTURE AUGMENTATION SYSTEMS

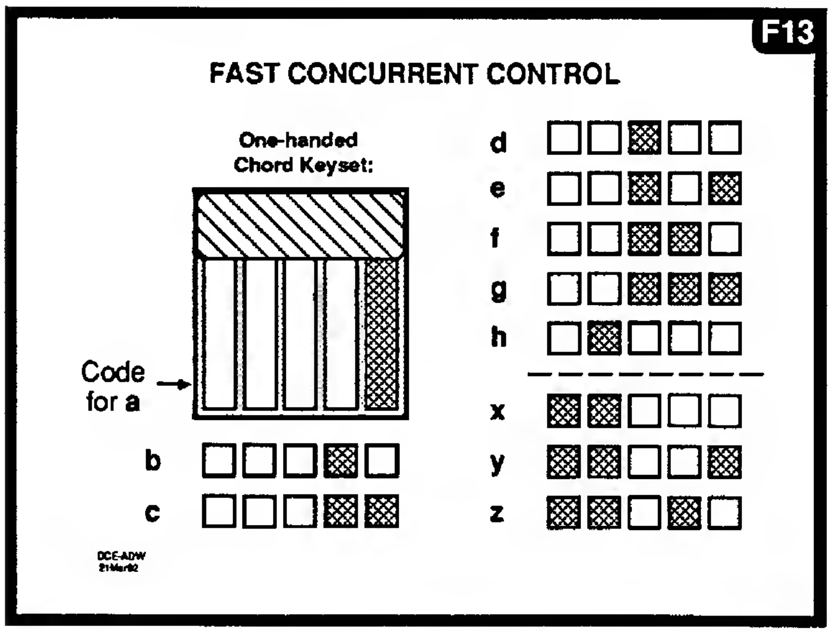
Skilled tool users will be able to gain real benefit from shorter and shorter response times . . .

with diminishing returns not likely to set in before 1/4 second.

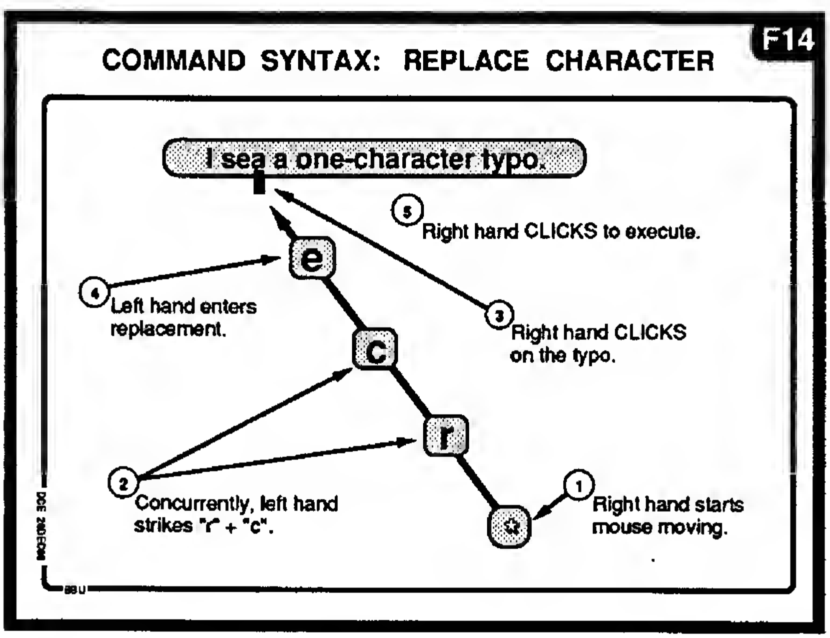
We pursued maximal improvement in capability -- and assumed that significant Human System changes were fair game.

The system architecture was later developed with explicit provisions for "Grades of User Proficiency."

(See Bib-8).



The chord keyset was provided as an option which amply repaid the learning time with unparalleled speed and flexibility of system operation.



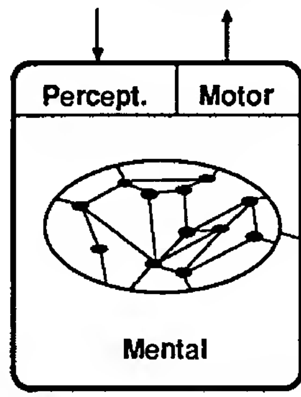
In the average time required to move the mouse to a target object, or to a menu item, a reasonably skillful keyset user can simultaneously enter five to seven characters.

Pre-designation of command function, in parallel with mouse-movement to the target, is thus much more efficient than is the sequential process of selecting the target object and then designating the function.

Notes

F15

ONE'S CONSCIOUS KNOWLEDGE, REPRESENTED BY A COMPLEX STRUCTURE OF CONCEPTS



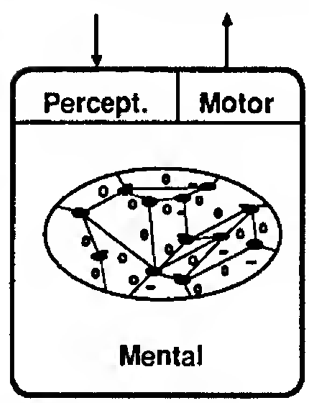
We have concepts for things & for relationships between concepts, etc.

Raw look, as if we could see the way we actually hold conceptual knowledge.

Notes

F16

KEY INVENTION: USING EXPLICIT SYMBOL STRUCTURES TO REPRESENT OUR CONCEPTS



We could hardly think or communicate otherwise.

Some of the linkage is unconscious and automatic.

But formal concepts and relational linkages are fundamentally important to our language.

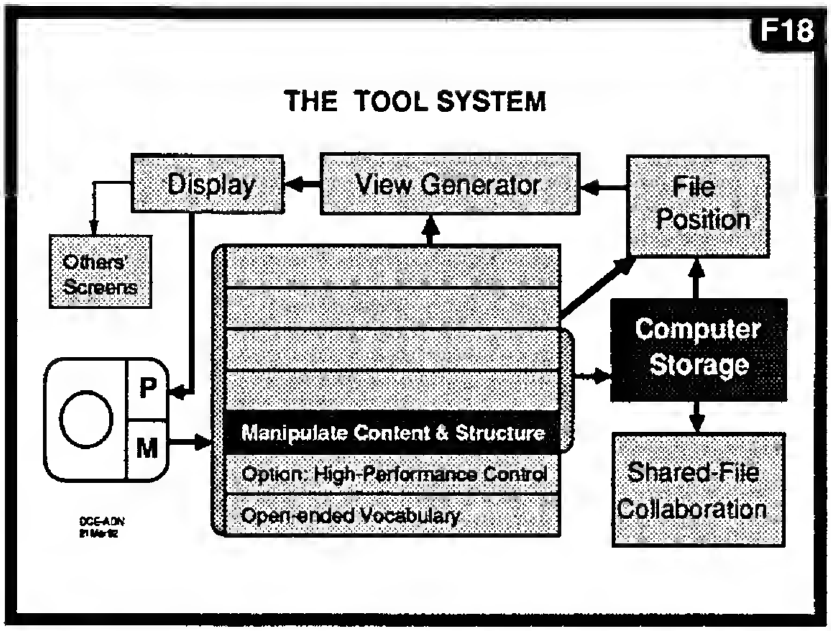
This introduced a fundamental paradigm shift.

F17

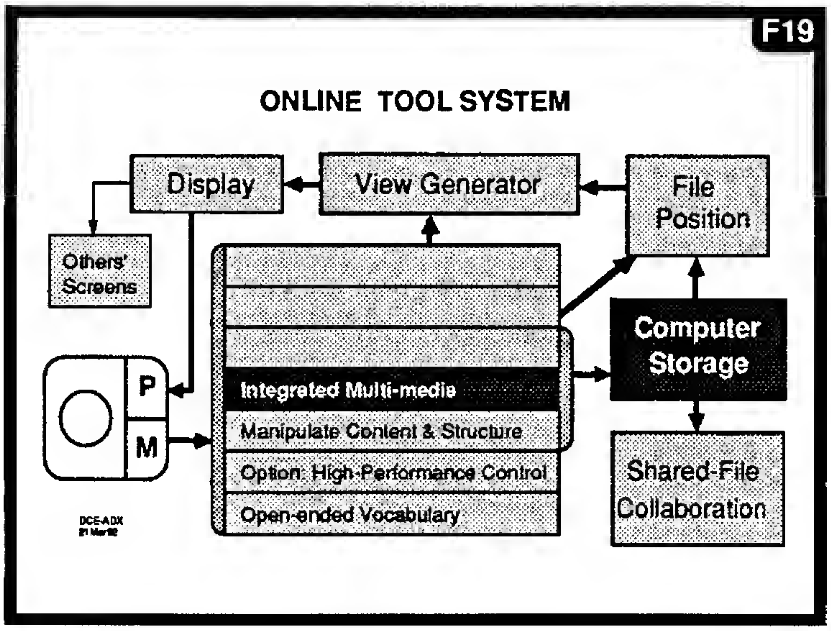
NEW: MAKING AN EXTERNAL MAP OF THE HUMAN'S INTERNAL CONCEPT STRUCTURE

- Computer-aided writing
- Explicit file structure that models thought and knowledge structure
- Computer-aided structuring

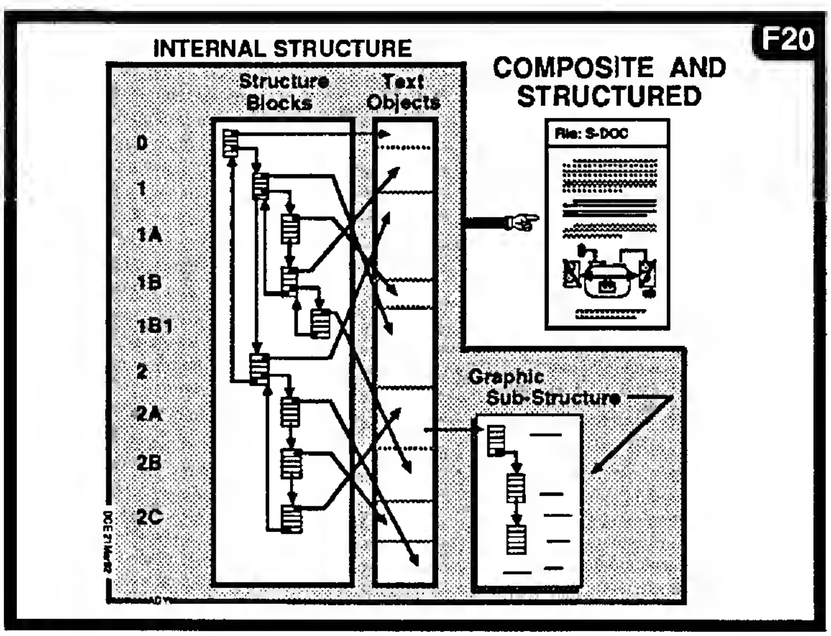
Opportunity: Break from linear paper; Use a truer external representation.



Emergence of "Outline Processing."



Emergence of integrated, multi-media, electronic documents.



Emergence of explicit conceptual objects within the computer file -- enrichens the users' conceptual model and command language.

A very valuable "new paradigm" feature that hasn't been generally appreciated (yet).

F21

PARADIGM SHIFT

New: **Using names and addresses for things and places in the structure**

Opportunity: let it be part of your mental map; yields more computer help.

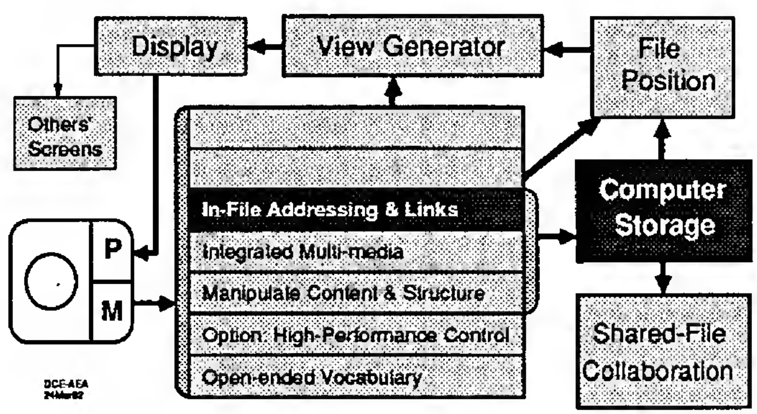
New: **Harnessing names and addresses for distant jumping or manipulating**

Opportunity: use human ability to know names and structural locations.

Notes

F22

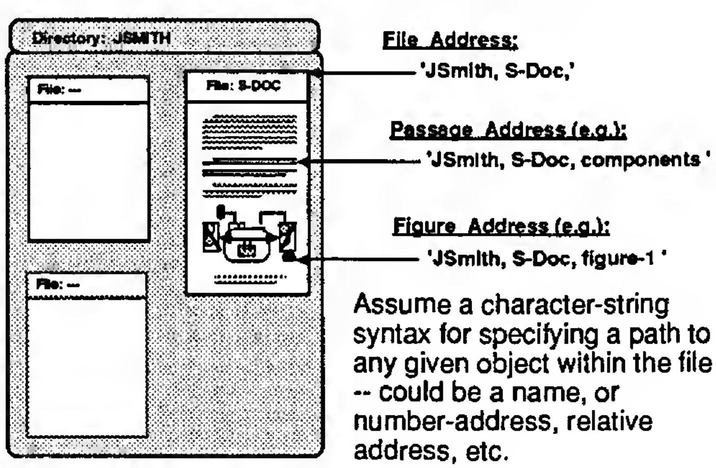
ONLINE TOOL SYSTEM



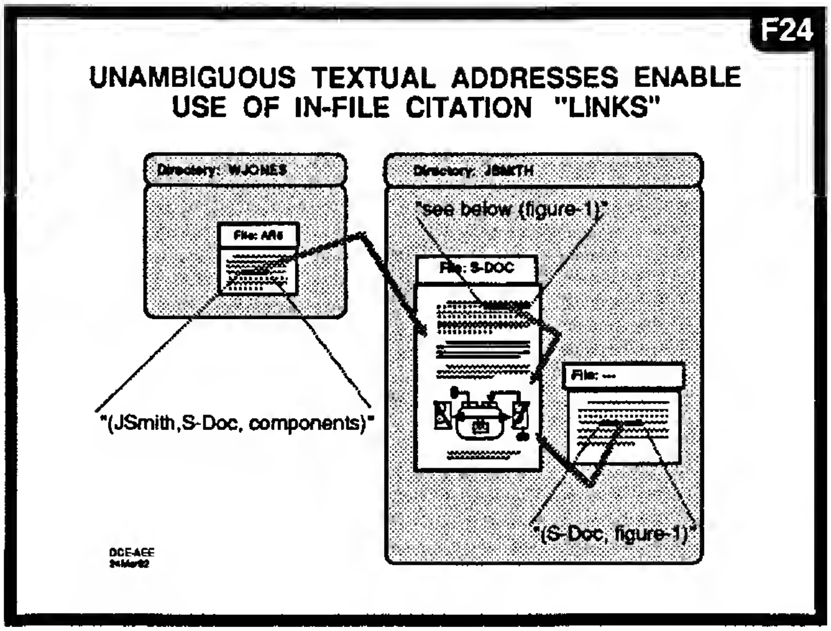
Notes

F23

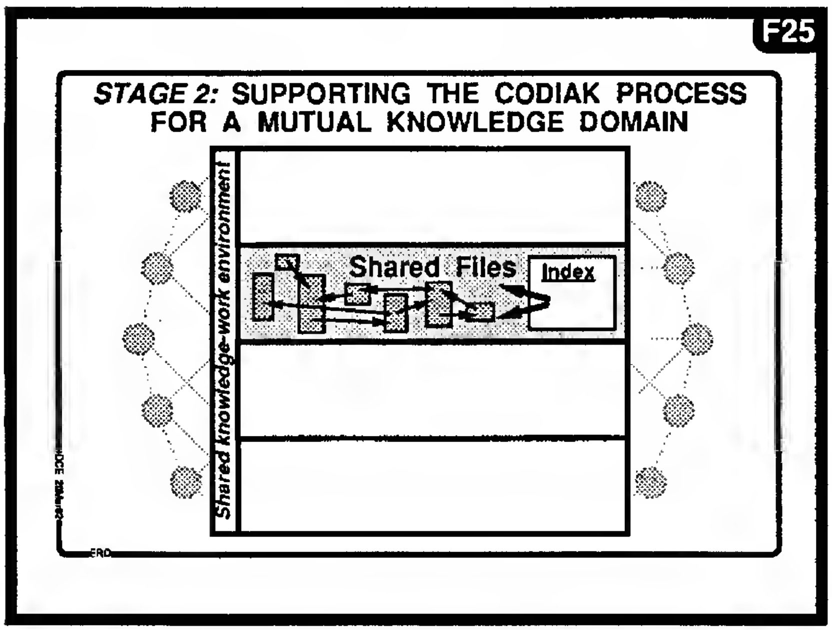
A GREAT DEAL OF VALUE CAN BE DERIVED FROM HAVING IN-FILE ADDRESSES! E.g.:



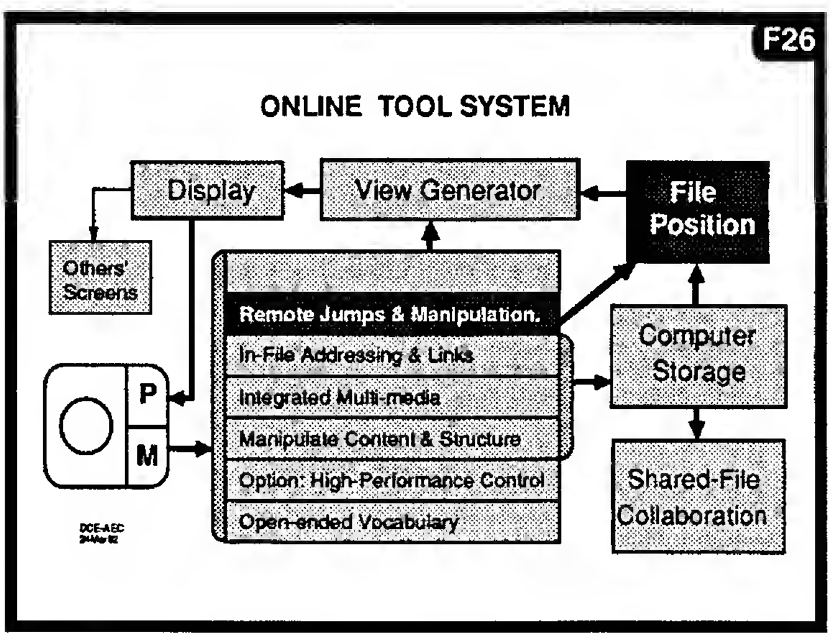
Assume a character-string syntax for specifying a path to any given object within the file -- could be a name, or number-address, relative address, etc.



Notes

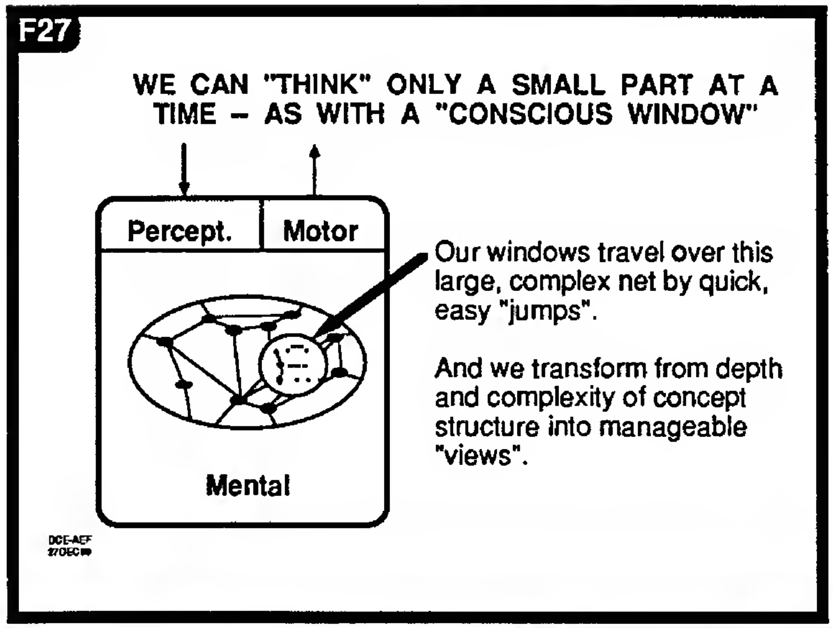


Notes



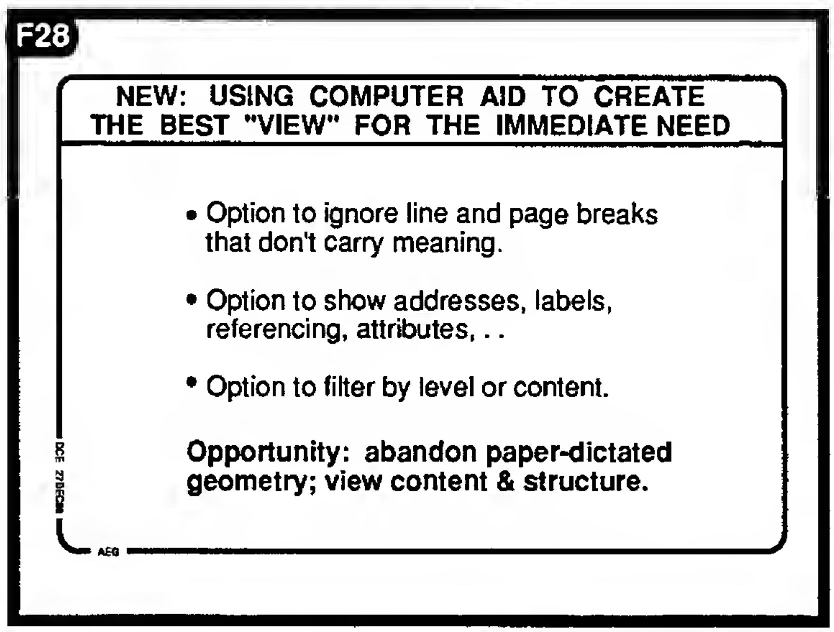
One-hop "jumping" to explicit locations within any document is a very valuable capability provided by flexible naming and addressing conventions. And these same conventions also provide ready handles for users to specify any other operation upon the "remote" objects.

Important realization emerged here - - our minds not only do very fast one-hop jumps to a "distant conceptual object," but they also offer us a quick means of "zooming" to details or overviews.

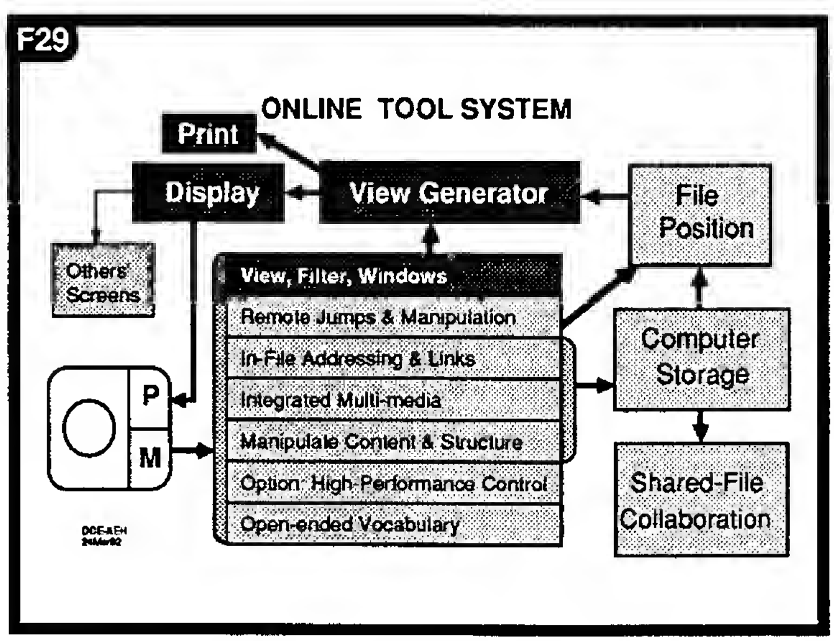


This led to another very valuable different-paradigm feature in NLS.

"View-control options" are so valuable that it can only be a matter of time before the principles and practices are integrated into general use.



Notes



F30

VIEWS

<ref. -- OAD,2250,7:cmsy> next view →<:ebt>

7 CONTROLLING THE VIEWS

7a A user of a book, or of most on-line text systems, is constrained to viewing the text as though he had a window through which he sees a fixed, formatted document. But as described below, our worker can view a section of text in many ways, depending upon his need of the moment.

__VIEW__: All levels; Numbers On; All line per statement; Blank lines.

The remaining foils show a variety of views which a user could evoke when studying (and in case of Foils F37 and F38, modifying) the structural content of an AUGMENT document – in this case, Bib-20, Section R, page 9.

F31

VIEWS

<:ebt> next view→<:zg>

7 CONTROLLING THE VIEWS

7a A user of a book, or of most on-line text

7b MULTIPLE WINDOWS

7c WINDOW VIEWS

7d USER-SPECIFIED SEQUENCE

__VIEW__: 2 levels; Numbers On; 1 line per statement; Blank lines.

You are invited to study Bib-22 in Section Q, for details of viewing (and addressing, and jumping, etc.).

F32

VIEWS

<:zg> next view <:l>

7 CONTROLLING THE VIEWS
7a A user of a book, or of most on-line text
7b MULTIPLE WINDOWS
7c WINDOW VIEWS
7d USER-SPECIFIED SEQUENCE

__VIEW__: 2 levels; Numbers On; 1 line per statement; No blank lines; Branch only.

Notes

The remaining foils show a variety of "views" which a user could evoke when studying (and in case of Foils F37 and F38, modifying) the structural content of an AUGMENT document – in this case, Bib-22, Section Q, page 9.

F33

VIEWS

<:l> next view→<:c>

7 CONTROLLING THE VIEWS
7a A user of a book, or of most on-line text
7b MULTIPLE WINDOWS
7c WINDOW VIEWS
7d USER-SPECIFIED SEQUENCE
8 TRAVELING THROUGH THE WORKING
8a An important provision in AUGMENT
8b Traveling from one view point to another
9 MODIFYING THE DOCUMENT
9a Given the array of capabilities described

VIEW: 2 levels; Numbers On; 1 line per statement; No blank lines; All Plex.

Notes

F34

VIEWS

<:c> next view→<:n>

7 CONTROLLING THE VIEWS
7a A user of a book, or of most on-line text
7b MULTIPLE WINDOWS
7b1 For whatever total screen area is
7b2 (Note: Cross-file editing can be
7b3 User-adjustable parameters are
7c WINDOW VIEWS
7c1 STRUCTURE CUTOFF. Show only
7c2 LEVEL CLIPPING. For the
7c3 STATEMENT TRUNCATION. For

VIEW: All levels; Numbers On; 1 line per statement; No blank lines.

Notes

F35

VIEWS

<:n> Jump with view→<:ebmg>

CONTROLLING THE VIEWS
A user of a book, or of most on-line text
MULTIPLE WINDOWS
For whatever total screen area is
(Note: Cross-file editing can be done at
User-adjustable parameters are used to
WINDOW VIEWS
STRUCTURE CUTOFF. Show only the
LEVEL CLIPPING. For the designated
STATEMENT TRUNCATION. For those

VIEW: All levels; Numbers off; 1 line per statement; No blank lines.

F36

VIEWS

<:ebmg>

7c WINDOW VIEWS
7c1 STRUCTURE CUTOFF. Show only the
7c2 LEVEL CLIPPING. For the designated
7c3 STATEMENT TRUNCATION. For those
7c4 INTER-STATEMENT SEPARATION.
7c5 (Note: The foregoing view controls are
7c6 STATEMENT NUMBERS AND NAMES.
7c7 FROZEN STATEMENTS. A worker may
7c8 USER-SPECIFIED CONTENT FILTERS.

VIEW: 3 levels; Numbers on; 1 line per statement; No blank lines; Branch only.

Notes

F37

VIEWS

9b 9a
Move Branch (to follow)

9 MODIFYING THE DOCUMENT
9a Given the array of capabilities described
9b Concurrent use of mouse and keyset also
9b1 Keyset hand strikes "m" and "b" (for
9b2 The mouse hand depresses the
9c A few extra verbs are useful for structure
9d A major source of structure-modification
9e (Note: I just had myself timed for this
9f In our view, interactive computer support

Handles structural branch of any size.
(Can type Stmt Nums or click anywhere on stmt.)

Notes

F38

VIEWS

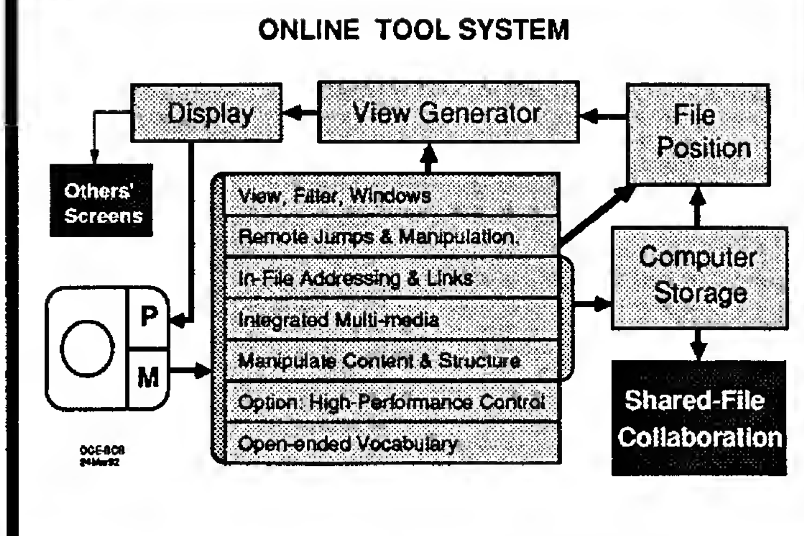
9 MODIFYING THE DOCUMENT
9a Given the array of capabilities described
9b Concurrent use of mouse and keyset also
9b1 Keyset hand strikes "m" and "b" (for
9b2 The mouse hand depresses the
9c A few extra verbs are useful for structure
9d A major source of structure-modification
9e (Note: I just had myself timed for this
9f In our view, interactive computer support

***After the move:** Branch 9b used to be 9d (and 9c was 9b; 9d was 9c).*

Notes

Notes

F39



Notes

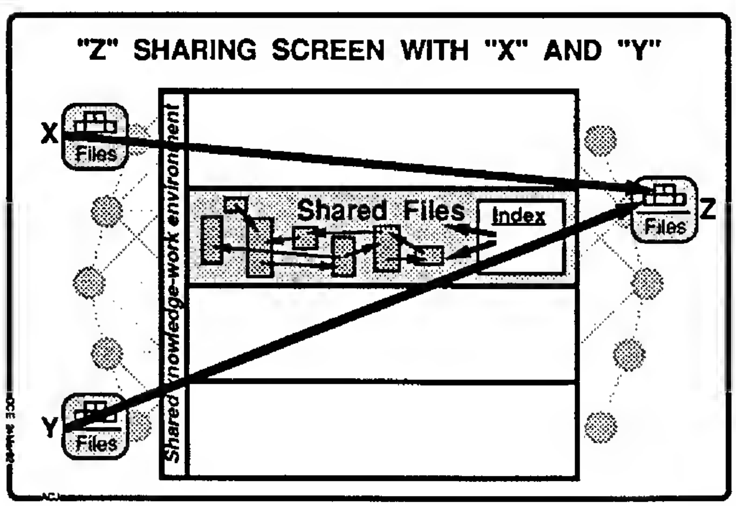
F40

A SHARED SCREEN FEATURE HAS MANY USES

Function	Examples
• Jointly reviewing and/or editing a document	"Let's finalize the wording for that section so we can go ahead and sign."
• Guided tours of the knowledge domain	"Can you show me those figures?"
• Online coaching	"Can you show me how you compiled that code?"
• Meeting support	Preparation, formulating/displaying (dynamic) agenda and group notes, presenting/retrieving docs, full remote participation...
• More ...	

F41

Shared-screen conferencing with multiple parties, and control-exchange capability -- operative since 1972 -- always assumed to be a future certainty as a general utility feature.



F42

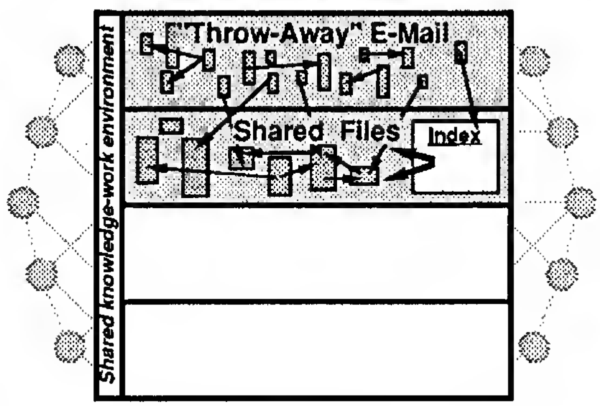
*** PARADIGM SHIFT ***

Recipients of emailed hyperdocuments should to be able to click on the links to follow the cited references!

Notes

F43

STAGE 3: SUPPORTING THE CODIAK PROCESS FOR A MUTUAL KNOWLEDGE DOMAIN



Notes

F44

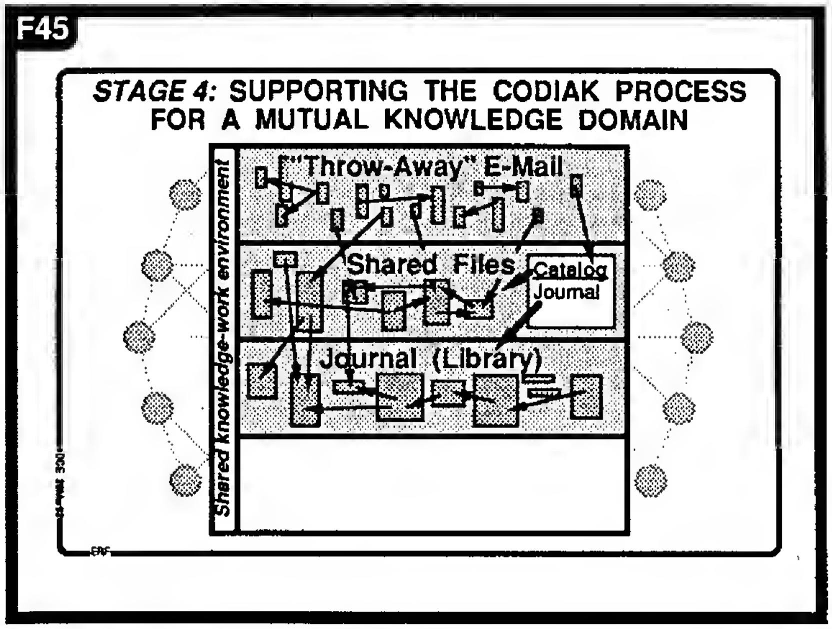
*** PARADIGM SHIFT ***

Email has opened whole new horizons for organizations, but also opened the "floodgates" for information overload. Too much, too hard to manage, and the important knowledge that might have enduring value is buried or lost.

Try providing an integrated library-like system. Just prepare a submittal form for the message or document, and an automated "clerk" assigns a catalog number, stores the item, notifies recipients with a link for easy retrieval, notifies of supercessions, catalogs it for future searching, manages document collections, ...

Notes

Integrated mail system in use since 1970. The unique NLS/AUGMENT Journal System became operative that same year -- a special form of "hyperdocument publishing" of uniquely high value in a CODIAK process.



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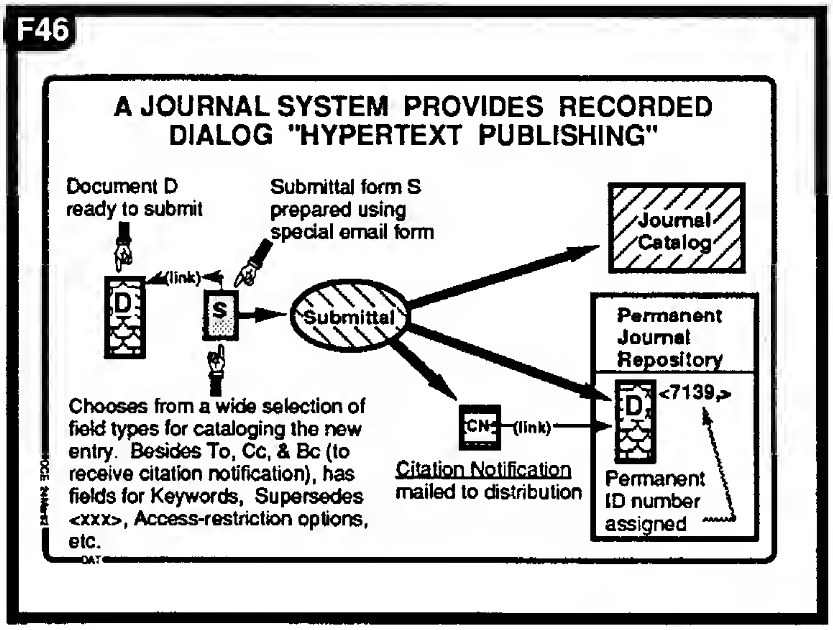

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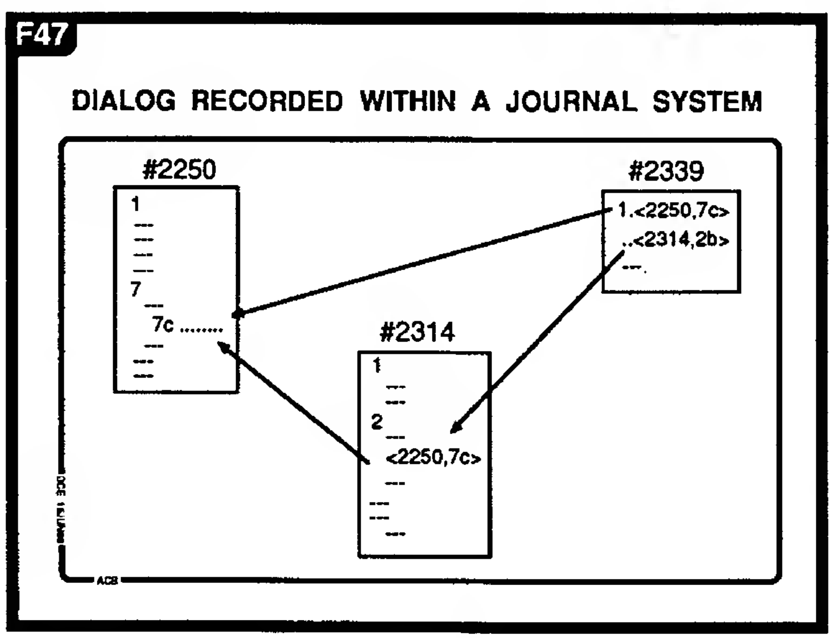


F48

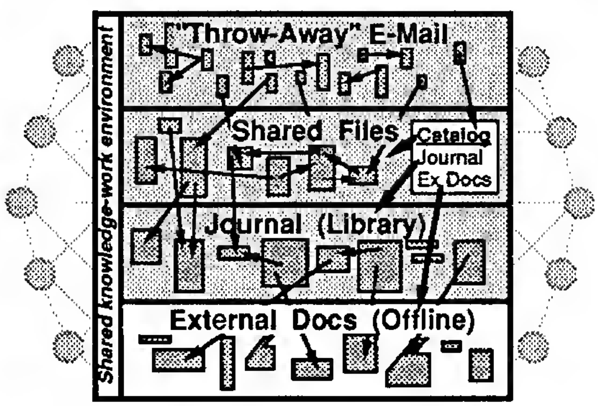
A JOURNAL SUPPORTS RECORDED DIALOG

Function	Examples
• Formalized email	Memos, trip reports
• Online conferencing	"Anyone have suggestions for X?"
• Document exchange	"Here's the latest draft for review -- note major changes to <sect-f>
• Document review	"Inconsistencies in <2a> and <5d>..."
• Doc management	Storing intermediate states of proj docs
• Doc accountability	Versions tracked, signatures verifiable
• Intelligence collection	"Here's the latest on Y -- note esp. <4b>"
• More ...	

Notes

F49

STAGE 5: SUPPORTING THE CODIAK PROCESS FOR A MUTUAL KNOWLEDGE DOMAIN



Our XDOC System flourished until about 1973 -- dying then from lack of appreciation within our sponsor community.

XDOC entries were indexed in the same catalog system that supports the Journal.

Likely evolve toward a general, unified records management system -- managing both online and external records in an integrated manner.

F50

CONTROLLING EXTERNAL DOCUMENTS IS AN IMPORTANT COLLABORATIVE FUNCTION

- Books, clippings, articles, etc.
- Catalogued and indexed via same tools as for "internal," on-line documents.
- Important purpose is to support citation links to external material.
- Another purpose is the common one of facilitating retrieval and access.

An integrated external-document (XDOC) system was planned from the beginning to be a part of what we now call the CODIAK capability.

It remains a basic element in expected future Hyperdocument Systems.

Basic functional element in an effective CODIAK capability.

F51

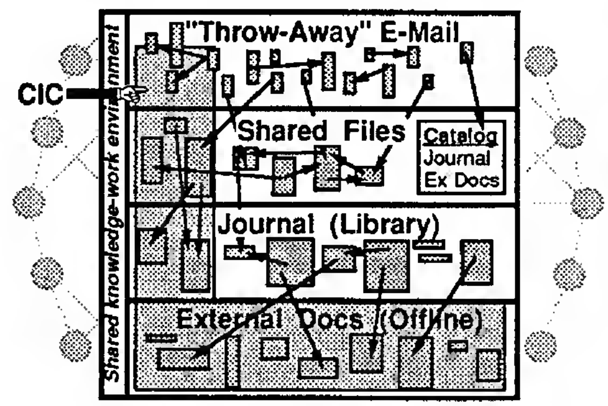
A COMMUNITY INTELLIGENCE SYSTEM CAN BE DISTRIBUTED AND CO-OPERATIVE

- Significant capability would be provided by Dialog Support and External Document Control.
- Bibliography, annotations, critiques and discussions thereof entered freely by Community participants.
- Trained support staff can add important elements of service.

Notes

F52

A COMMUNITY'S INTELLIGENCE COLLECTION (CIC) WILL INVOLVE ALL RECORD TYPES



Notes

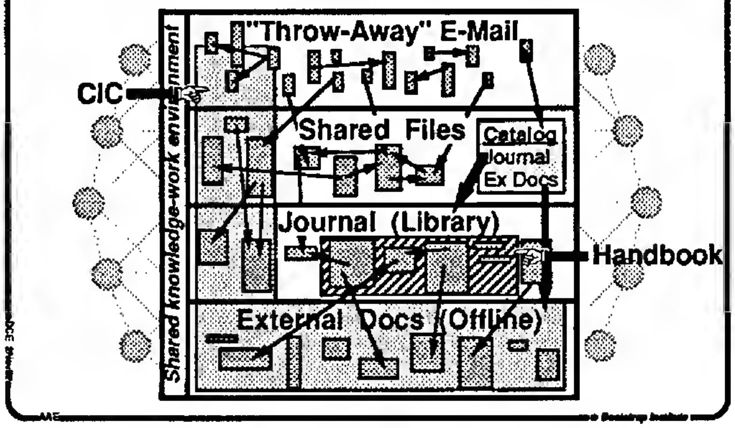
F53

SPECIAL SUPPORT NEEDED TO MANAGE A DYNAMIC, EVOLVING, COMMUNITY "HANDBOOK"

- From Dialog and Intelligence records.
- Dynamically maintained, to reflect current understanding, commitments, standards, etc., as relevant to Community purpose and interests.
- Concurrent, on-line & publication; CBI.
- Active target for ongoing dialog.

F54

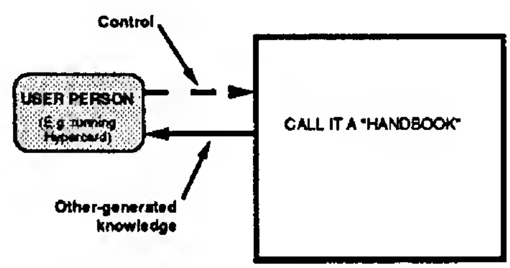
THE HANDBOOK: A COMMUNITY'S INTEGRATED EVOLVING KNOWLEDGE BASE



Notes

F55

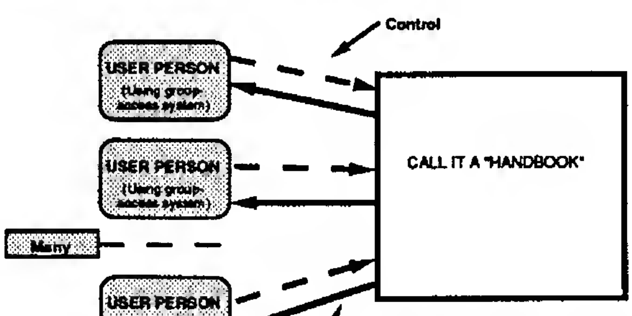
STRUCTURED HYPERTEXT: PROVIDING NEW STUDY POWER OVER ESTABLISHED BODY OF KNOWLEDGE;



Notes

F56

STRUCTURED HYPERTEXT: VERY USEFUL TO SERVE A COMMUNITY WITH A COMMON REFERENCE BASE.

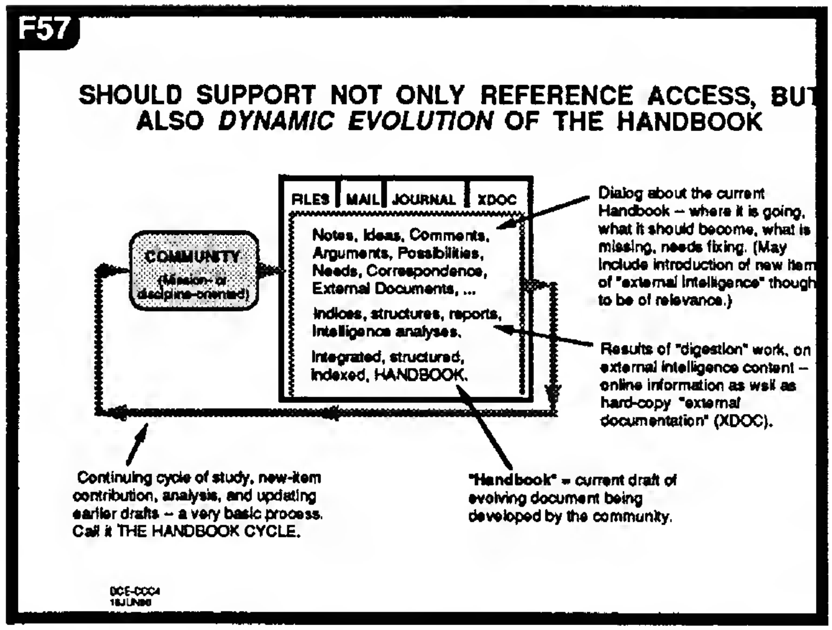


Other-generated knowledge

The next step: provide for the community to generate, collaboratively, its own "Handbook" (or knowledge product).

Notes

Bringing out the "system" aspect -- to support wide-area, generic CODIAK processes.



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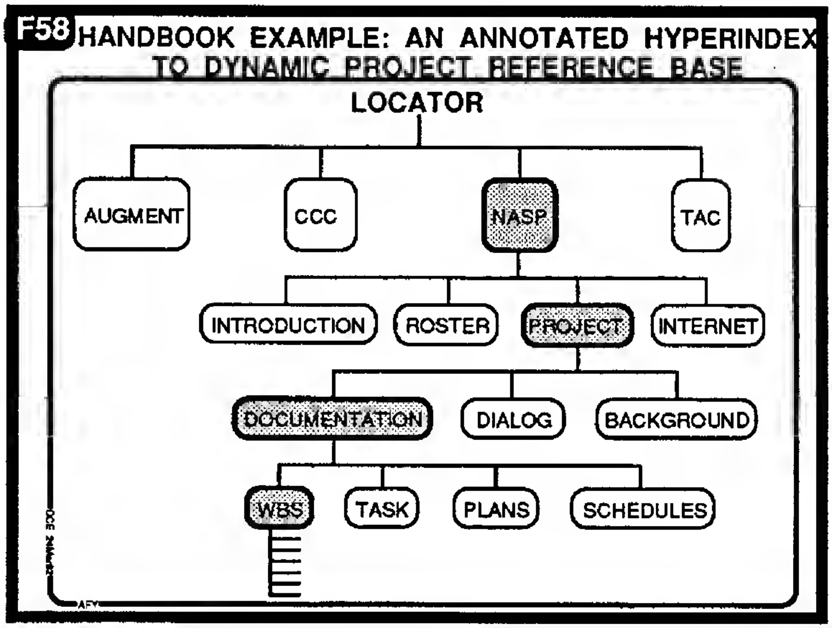

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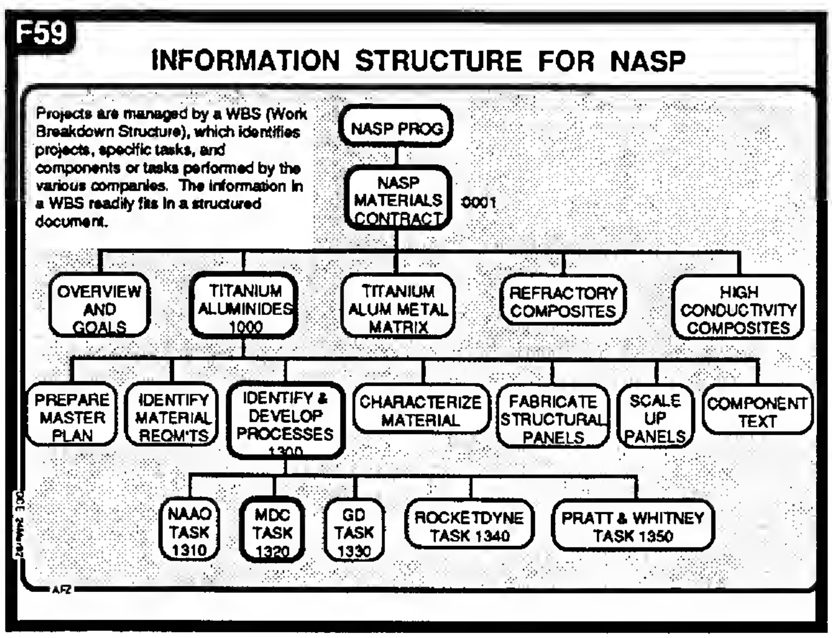


F60

SUPPORTING THE *CODIAK* PROCESS

- Recorded dialog, highly collaborative, within an open hyperdocument system -- integrated with E-mail, shared files, and permanent, cataloged "library" system -- as well as with CIC and Handbook.
- Community Intelligence Collection (CIC) -- in highly useable, hyperdocument form -- integrated with recorded dialog and Handbook.
- Community Handbook -- a dynamically evolving, hyperdocument, "collaborative-knowledge product" -- integrated with recorded dialog and CIC.

Notes

F61

Hypothesis #5: Open Hyperdoc System (OHS)

An underlying open hyperdocument-system infrastructure is needed to support interoperable, high-performance CODIAK work.

- **Requirements for a Hyperdocument System**
  - **General Provisions**
  - **Recorded Dialog**
  - **Intelligence Collection**
  - **Electronic Handbook**
- **Toward *Open* Hyperdocument Systems**
- **Issues for the Info-Sys Marketplace**

Notes

F62

TOWARD AN *OPEN* HYPERDOC SYSTEM FOR WIDE-AREA CODIAK SUPPORT

Moving toward providing integrated, interoperable, *seamless* hyperdocument systems to support the CODIAK process within and across organizations.

(Note: Assumes full provision for restricting access as desired).

Notes

Notes

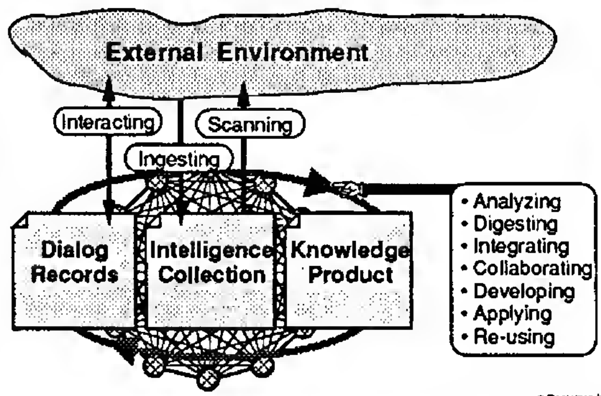
F63

The need for CODIAK interoperability will extend the scope of standards.

Notes (Same as E7)

F64

BASIC KNOWLEDGE PROCESS RESULTS IN A DYNAMICALLY EVOLVING KNOWLEDGE BASE



Notes

F65

OHS: TO SERVE "ALL DOCUMENT NEEDS" WITHIN VERY LARGE PROJECTS

Large, small: formal, legal documents or informal working notes.

"OHS E-mail" to convey a general-purpose "hyperdocument" of any size.

Requirements, specifications, design details, status reports, work breakdown structures, change orders.

References, instructions, policy, glossary, RFP, bids, work orders, "even" source code.

F66

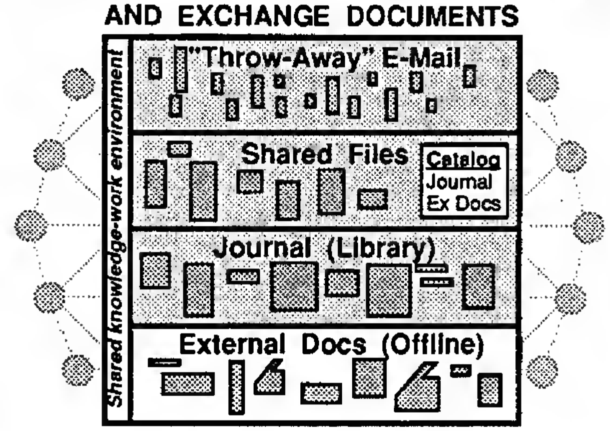
ESSENTIAL ELEMENTS OF AN OHS

- Mixed-object documents
- Explicitly structured documents
- View control of objects' form, sequence and content
- The basic "hyperdocument"
- Hyperdocument "back-link" capability
- Hyperdocument "library system"
- Hyperdocument mail
- Personal signature encryption
- Shared-window teleconferencing
- Inter-linkage between hyper-documents and other data systems
- Link addresses that are readable and interpretable by humans
- Every object addressable
- Hard-copy print options to show addresses of objects and address specification of links
- External-document control
- Access control
- More

See <Bib-26@11> in Section S.

F67

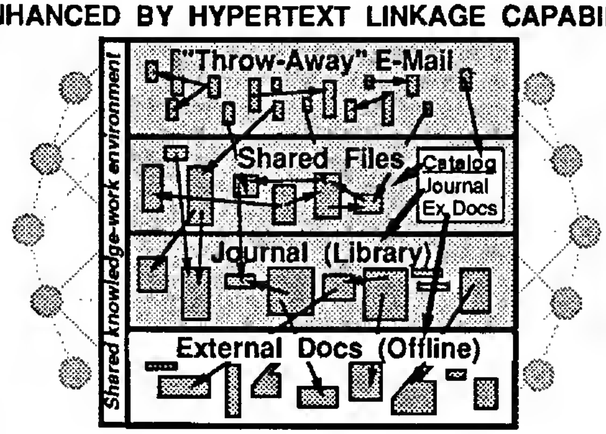
INTEROPERABLE KNOWLEDGE DOMAINS SHARE AND EXCHANGE DOCUMENTS



Shows the generic sharing requirement for an interoperable hyperdocument system.

F68

KNOWLEDGE-DOMAIN INTEROPERABILITY GREATLY ENHANCED BY HYPERTEXT LINKAGE CAPABILITY



Notes

Notes

F69

AN OHS WOULD INTEGRATE AND SUPPORT MANY IMPROVEMENT PROGRAMS

Given an open hyperdocument system, how much specialazed software would be needed for such as groupware, concurrent engineering, CALS (online document delivery), enterprise integration, organizational learning, etc.?

How much could be saved?

Notes

F70

Hypothesis #5: Open Hyperdoc System (OHS)

An underlying open hyperdocument-system infrastructure is needed to support interoperable, high-performance CODIAK work.

- **Requirements for a Hyperdocument System**
  - **General Provisions**
  - **Recorded Dialog**
  - **Intelligence Collection**
  - **Electronic Handbook**
- **Toward *Open* Hyperdocument Systems**
- **Issues for the Info-Sys Marketplace**

Notes

F71

OHS: SOME OF ITS EMERGENT REQUIREMENTS WARRANT MULTI-PARTY CONSIDERATION

"Multi-Party" -- major vendors and user organizations from the large-project industries will be affected.

"Requirements" such as:

> An "authored" document, including its "authored" links, must be isolatable, signable, mailable, archiveable, ...And each organization in the OHS "web" must be able to hold its own collection of private and public hyperdocuments.

F72

OHS: OPEN HYPERDOCUMENT SYSTEM; CHALLENGE FOR BOTH VENDOR AND USER ORGS

"Open" for guaranteed use across the spectrum of major computer & workstation platforms.

Suitable to support all document needs within very large projects -- across multiple organizations.

A working prototype exists: obsolete platform; but useable for important pilot applications.

An aerospace company assessing OHS implementation & utilization. Seeking interest among system vendors and large user orgs.

Notes

F73

IN THE GROUPWARE MARKET, THE USER-ORG COMMUNITY MUST BECOME MORE PRO-ACTIVE

Suppose, for instance, that larger user orgs became leaders in exploratory development of human-system improvements to harness downstream technologies.

And suppose that they also found practical ways to accellerate cooperative road-mapping of their common future info-sys functional and architectural requirements -- toward serving their critical and expensive org-evolution programs.

An OHS how many years sooner this way? Consider the value gained from each earlier-year's "no-island," open use of radical, online, OHS interop possibilities.

Notes

F74

THE NEW AUGMENTED-ORG PARADIGM POSES SERIOUS NEW MARKETPLACE CHALLENGES

If, with experience from evolutionary development, significant changes emerge in org processes to harness radical new collaborative technology, then:

How will the vendors get that experience in order to shape their groupware architectures?

How will non-exploring user organizations get that experience in order to know how to shop among the different vendor's offerings?

And what would a large user organization face five years after choosing a weaker basic architecture?

Notes

G

BOOTSTRAP SEMINAR
Nov 30 - Dec 2, 1992

Foil Set G:

ARCHITECTURE —

FOR INTEGRATED, SEAMLESS, EVOLVABLE INFO-SYSTEM

Douglas C. Engelbart, Bootstrap Institute

The papers in Sections O (Bib-20) provide a relatively thorough background rationale for this Section.

In particular, the concept of a "core knowledge workshop" for supporting future organizations clearly anticipated today's "enterprise integration" pursuits.

Section O (Bib-20) discusses partriculars of the following architectural modules, some of which argue for views about what should be done that aren't (yet?) generally held.

G1

BASIC FORMULATION FOR "THE AUGMENTED KNOWLEDGE WORKSHOP" <ref. -- 14724,1:elsym>

1. Concept of the knowledge workshop
2. Two ways in which augmented knowledge workshops are evolving
3. Basic assumptions about augmented knowledge workshops
4. Selected description of workshop capabilities
5. Plans for a workshop utility service
6. Conclusion: Need for long-term commitment

These next three foils are as could be viewed within a small AUGMENT window looking into Bib-8.

G2

3. BASIC ASSUMPTIONS ABOUT AUGMENTED KNOWLEDGE WORKSHOPS

3A. Embedded in a computer network

3B. Coordinated set of user interface principles

3C. Grades of user proficiency

3D. Ease of communication between, and addition of, workshop domains

3E. User programming capability

Notes

Notes

G3

BASIC "AKW ASSUMPTIONS" (Cont.)

3F. Availability of people-support services

3G. Cost decreasing, capabilities increasing

3H. Range of workstations and symbol representations

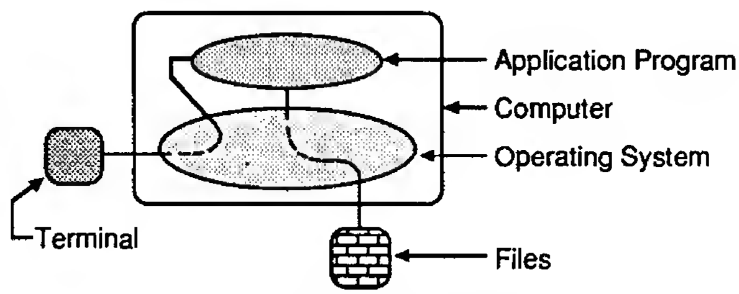
3I. Careful development of methodology

3J. Changed roles and organizational structure

Notes

G4

AN APPLICATION PROGRAM DEPENDS UPON AN OPERATING-SYSTEM PROGRAM – to provide

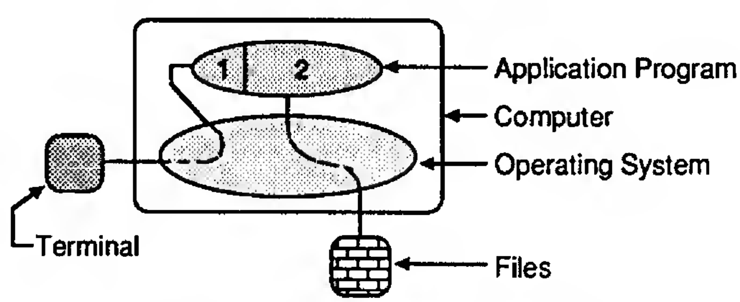


communication with files, terminals, printers, networks, etc.

Notes

G5

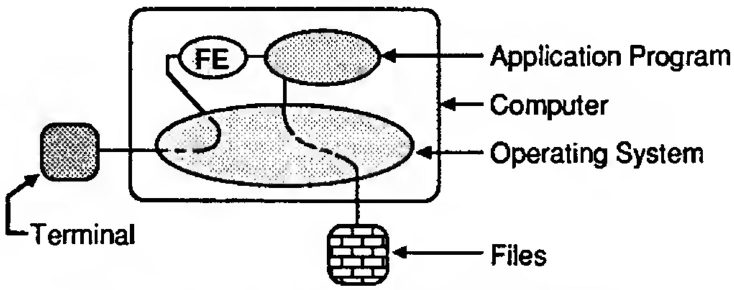
AN APPLICATION PROGRAM HAS TWO IMPORTANT BUT DIFFERENT TASKS:



(1) "Frontend" interfaces with the user;
(2) "Backend" does the application work.

G6

THE "FRONTEND" IS ACTUALLY A SPECIALIZED APPLICATION PROGRAM -- IN ITS OWN RIGHT

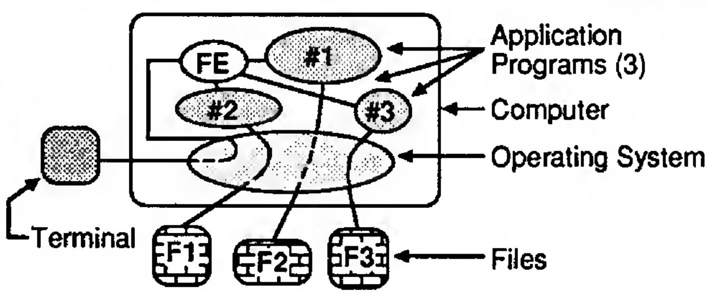


So, split it off and develop it as a separate "application specialty".

Notes

G7

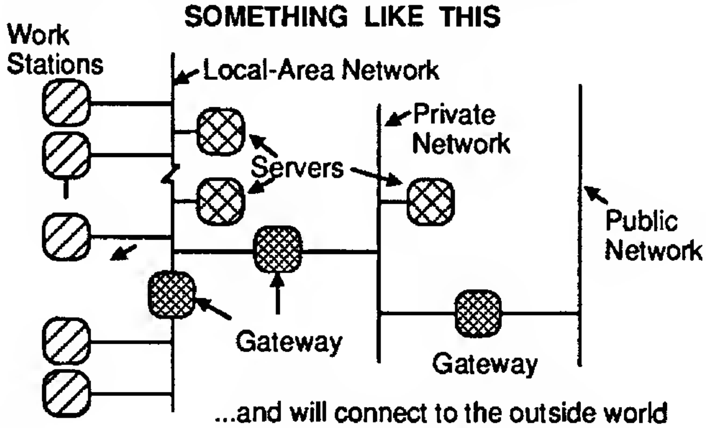
WHY NOT A GENERAL-PURPOSE FRONTEND, AN ALL-APPLICATION "USER INTERFACE SYSTEM"?



Notes

G8

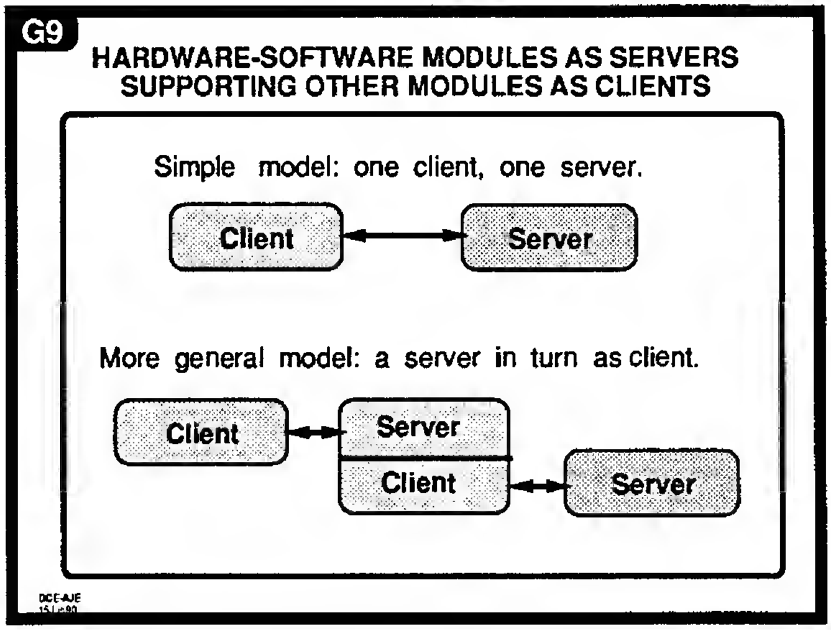
THE WORKSTATIONS, COMPUTERS AND DATA BASES FOR LARGE ORGANIZATIONS WILL LOOK SOMETHING LIKE THIS



...and will connect to the outside world via at least one public network.

Notes

Notes



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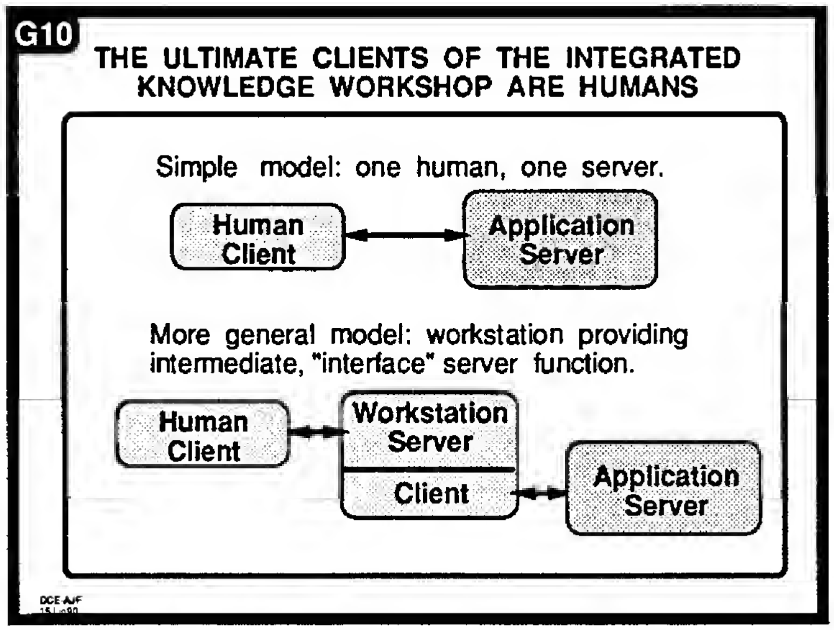

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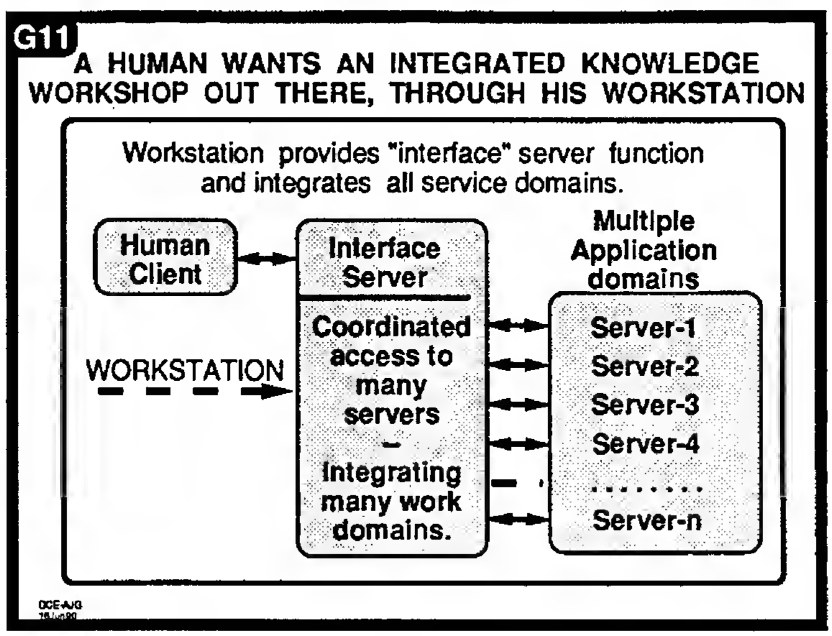
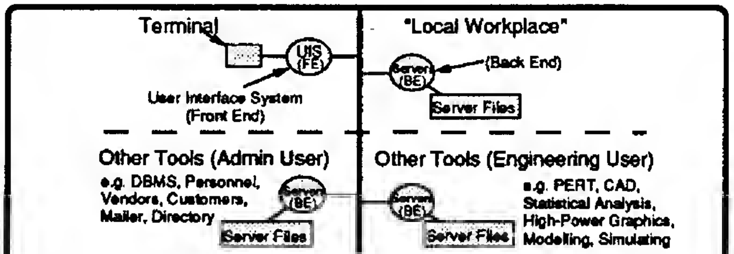


G12

EVOLVABLE ARCHITECTURE: OVERVIEW



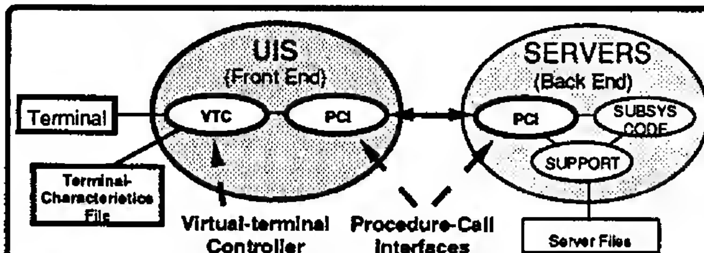
- Common standards for information exchange between servers.
- Consistent approach to user interface design across the servers.
- Different classes of users with different functionality on different workstations.
- Any part of the system can evolve with minimum disturbance to the rest of the system.

DCE-AJA
18Jun90

The "evolvability" character of an architecture needs definite recognition. Evolution must be accommodated not only within the technology infrastructure, but also within the users' domains of skill, knowledge, terminology, methods, roles, conventions, etc.

G13

APPLICATION-INDEPENDENT USER INTERFACE SYSTEM



Standard virtual-terminal classes -- for interaction semantics.

Standard remote-procedure-call protocol -- for interaction syntax.

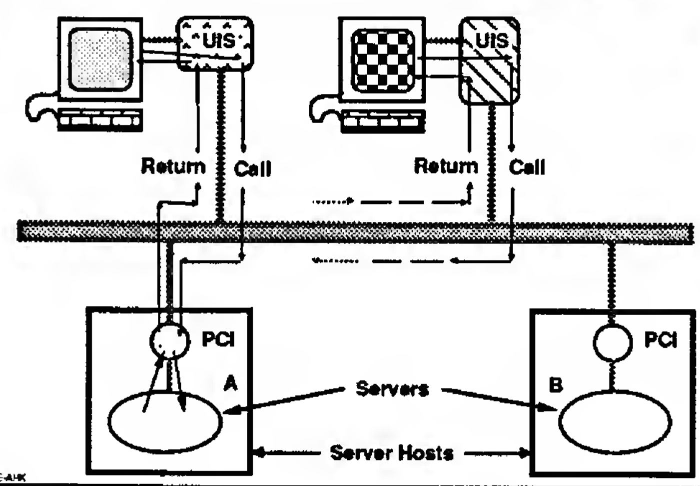
Use common standards for exchanges with workshop servers; facilitates their evolution!

DCE 18Jun90

Notes

G14

REMOTE PROCEDURE CALL PROTOCOL ENABLES INDEPENDENT USER INTERFACE SYSTEMS



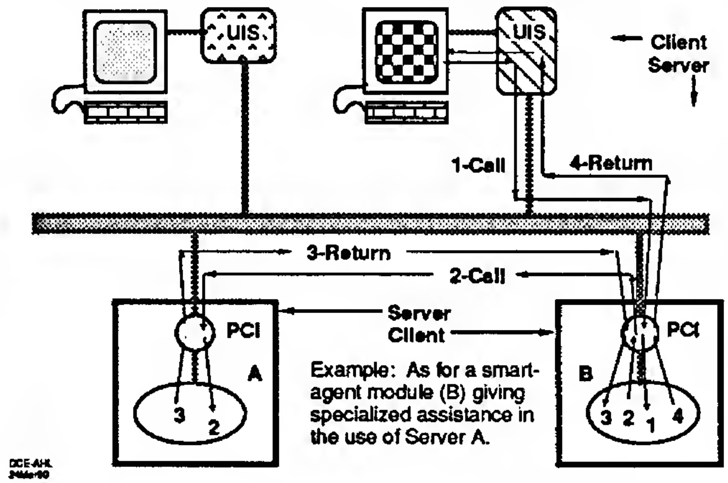
DCE-AHK

Notes

Notes

G15

THE R-P PROTOCOL ENABLES SERVERS TO BUILD UPON EACH OTHERS' CAPABILITIES



Smart agents ("knowbots") will undoubtedly play increasingly important roles in future "integrated workshops."

G16

AN APPROPRIATE WORKSHOP ARCHITECTURE PROVIDES A NATURAL, EVOLVING ROLE FOR AI

Modular, integrated open architecture enables the ready inclusion of special-service modules within any interconnectioin of other service modules.

In particular, smart-agent "AI" modules can steadily grow in their roles and usage within the indivdual and organizational knowledge workshops

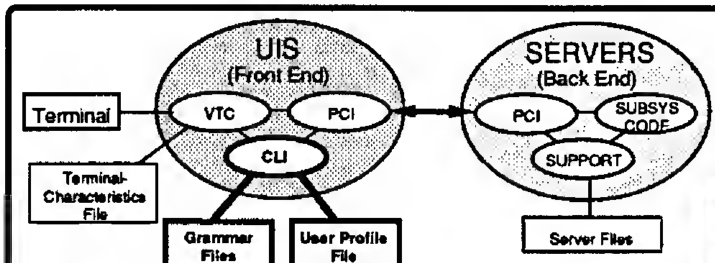
The smart agents, along with the other workshop functions and usage, should co-evolve with the methods, conventions, functions and skills of the humans. (A whole-system "engineering" approach.)

It will be very important for an organization to be able to support and shape the evolution of the working vocabulary utilized to operate within its common, "core workshop."

It seems almost inevitable that something like the grammar-driven CLI will have to emerge as a standard module.

G17

APPLICATION-INDEPENDENT USER INTERFACE SYSTEM



Grammar-driven Command-Language Interpeter (CLI) enables independent evolution of vocabulary for each class of user.

User-option profile enables independent evolution of style and expertise for each individual user.

G18

AUGMENT SUBSYSTEMS

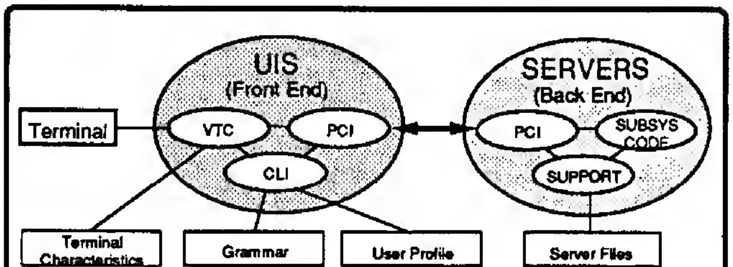
Executive Sys	Graphics	Publish
Base	Mail	Reach
Calculator	Matcher	Reminder
Compose	Modify	Retrieve
Conference	Programs	Slide
Encrypt	Proofs	Spell
Format		Table

Switching from one "subsystem" to another for an AUGMENT user is effected by a simple command. It does not change the configuration or content of his current windows, but provides a new set of tools to apply within that current content.

With an OHS standard support module, this architectural approach opens the door for very flexible, multi-vendor utilities market.

G19

EVOLVABLE ARCHITECTURE: FIRST-LEVEL OF DETAIL



UIS -- User Interface System

PCI -- Procedure-Call Interface

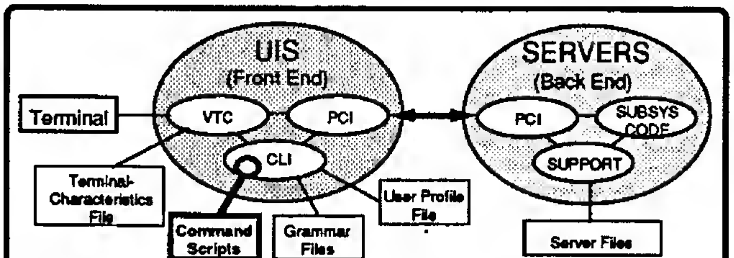
VTC -- Virtual-Terminal Controller

CLI -- Command-Language Interpreter

Notes

G20

APPLICATION-INDEPENDENT USER INTERFACE SYSTEM

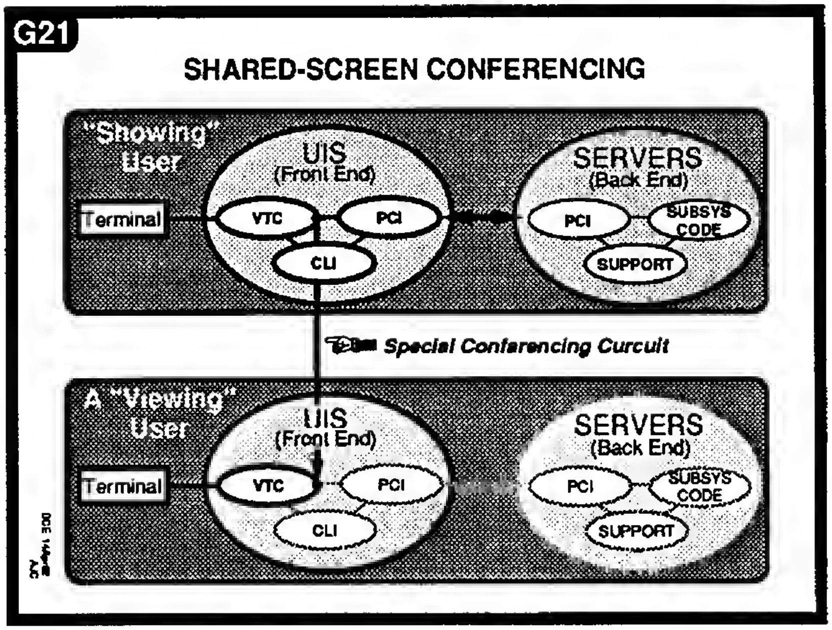


Scripts use same command vocabulary as does a user, including ability to switch grammar files.

Scripts, grammar files, user profiles -- all loadable from a user's home-workshop store, to enable shifting between working sites or workstation types.

This grammar-driven CLI approach very handily supports the "user-programming capability" (3E in Foil G2 and page 11 of Bib-8 in Section O) at a very high level. Basic test and branching features enable quite sophisticated functions to be developed by "non programmers." Scripts are written, documented and executed as regular text objects in AUGMENT files.

Use of the Conference Subsystem (see Foil G18) enables the setup and subsequent control of shared-screen conferencing. Control may be passed to any participant. The controlling user may employ any subsystem and operate upon any file to which the initiating, "showing" user has access. A participant may use any terminal equipment or workstation which the VTC module and a specific "characteristic" file provides for.



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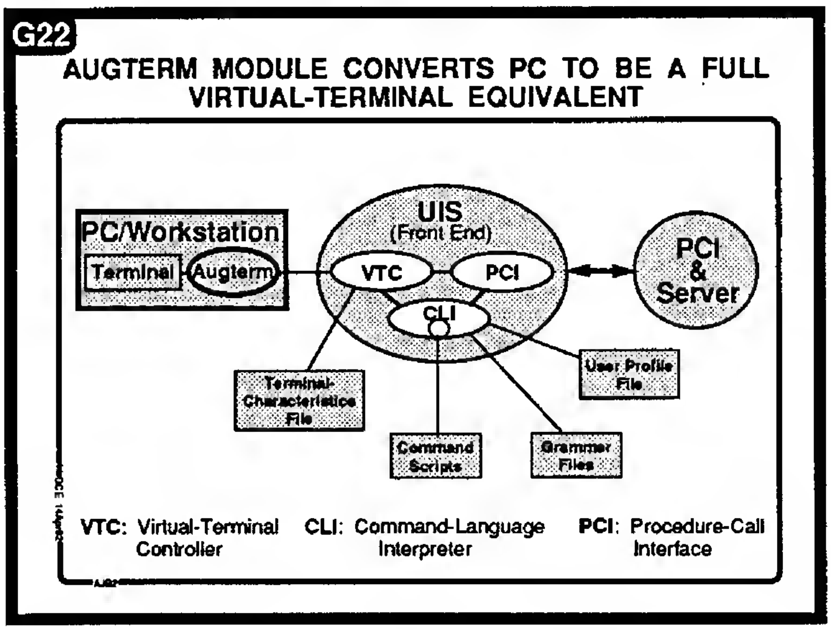

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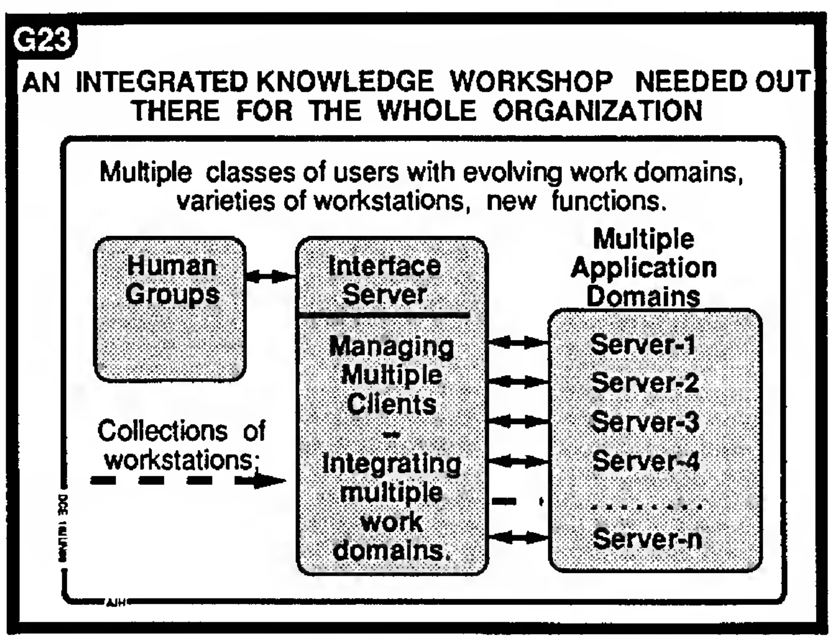
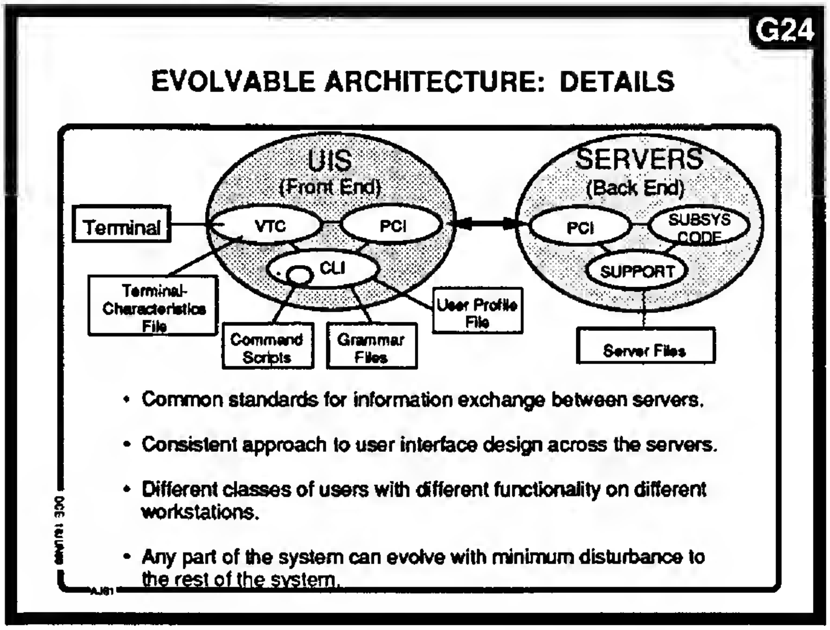
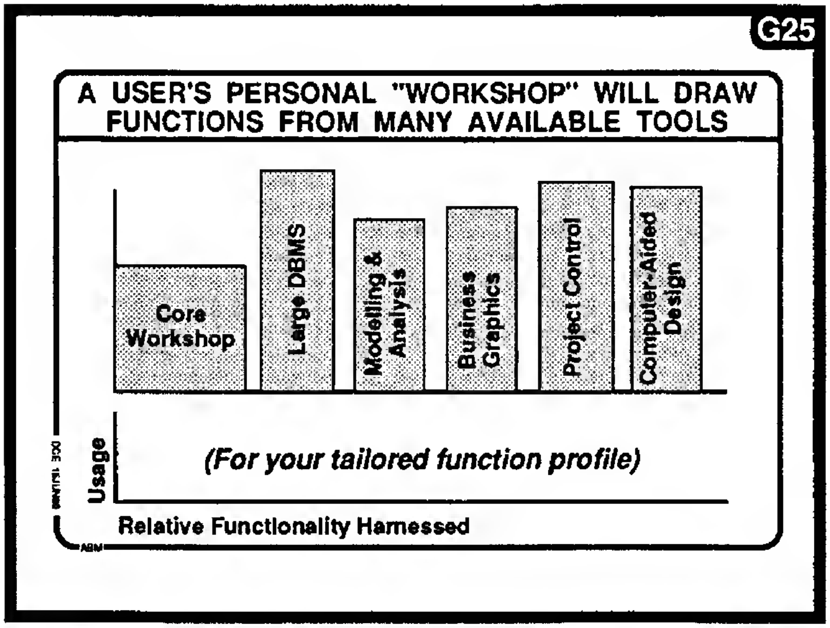




It is assumed here that different options will be available for the way the CLI interprets the "command" specifications that are compiled into the standard-format grammar files.

One set of options determines the extent of the vocabulary to be employed and another set determines the "look and feel" of the user interface.

A given user's choice of options are established (by him, or by a system support person) in his personalized "user profile" file, which he uses on whatever workstation he employs.



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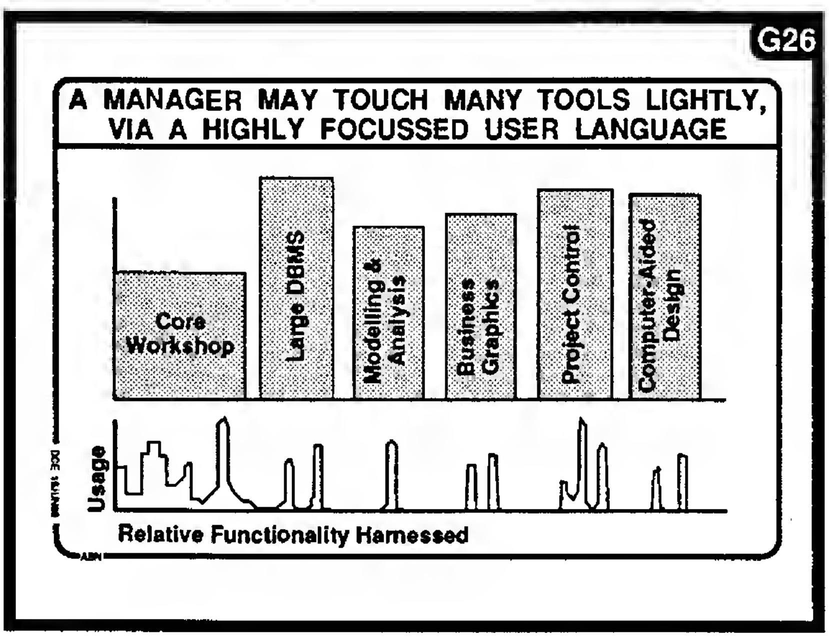
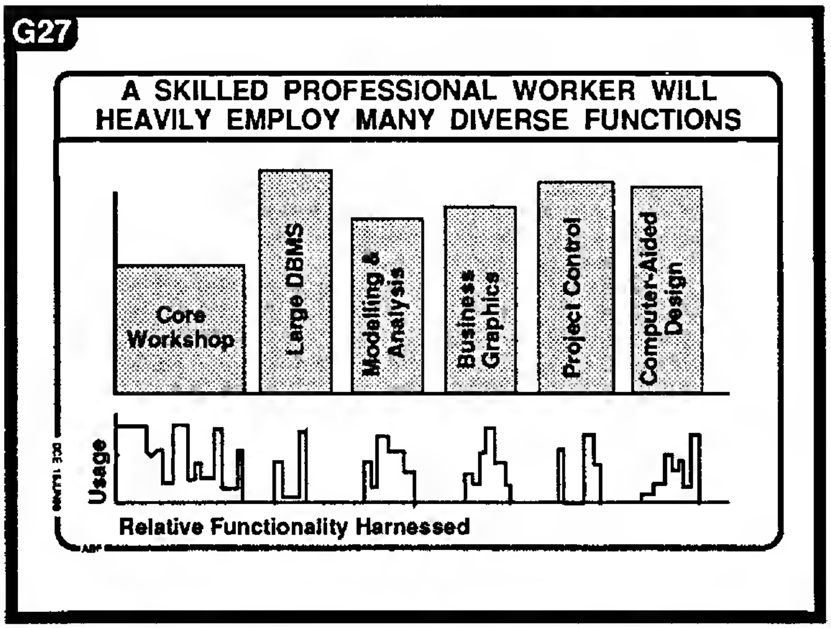


Notes

Notes



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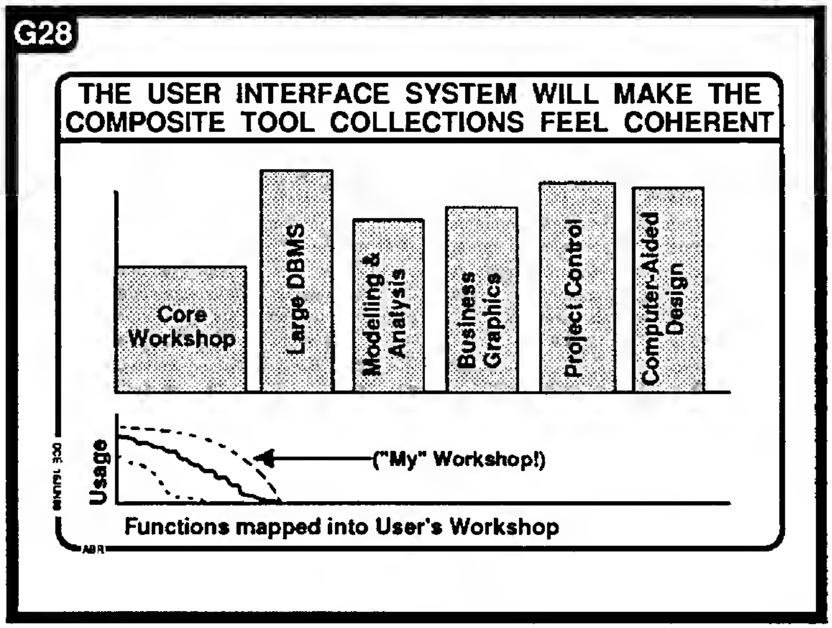


Notes

H

BOOTSTRAP SEMINAR
Nov 30 - Dec 2, 1992

Foil Set H:

HUMAN SYSTEM & PILOTS –

HUMAN SYSTEM ISSUES & EXPLORATORY PILOTS

Douglas C. Engelbart, Bootstrap Institute

Notes

H1

BASIC BOOTSTRAP CONCEPTS

Objective: Pursue high-performance org
Hypothesis #1: Whole-system Augmentation
Hypothesis #2: ABC's of Org Improvement
Hypothesis #3: Bootstrap Strategy
Hypothesis #4: Collab. Knowledge Work (CODIAK)
Hypothesis #5: Open Hyperdoc System (OHS)
Hypothesis #6: Joining forces in a C Community

(assumes major paradigm shifts throughout)

Notes

H2

Hypothesis #1: Whole-system Augmentation

Highly-developed work methods must evolve hand in hand with the tools, via exploratory pilot outposts in diverse application areas.

- Appreciating Human-System Contributions
- Human-System Elements of CODIAK Support
- Advanced Exploratory Pilots
- High-Performance Teams
- Conclusion

Notes

*As organizations face increasing complexity and urgency, their Human-System advancements must not only be commensurate with the technology explosion, the two must **stay in sync**. To gain ever higher performance, organizations must explicitly **co-evolve** the Human-Tool elements for an integrated, coherent capability infrastructure.*

Notes

H3

TRY IMAGINING THE HUMAN SYSTEM YOU'D HAVE TO CREATE IF YOU ACCEPTED A CHALLENGE:

You would be given enough people, possessing among them all of the necessary basic human capabilities, to take over an existing activity that will be assigned to you from a candidate list.

They will have intelligence, strength, health, size, etc., necessary for their jobs; all speak the same language, with a spectrum of general education.

But none will have the special knowledge, physical skills and conditioning, social skills and conditioning, etc. possessed by the just-departed staff.

Notes

H4

MORE CONDITIONS ON OPERATING YOUR NEW ENTERPRISE

You would take over all of the facilties, equipment, tools, records, etc. left behind yesterday by the successfully coping previous staff.

You can spend up to 5% of the previous operating budget on consultants and educational courses -- but you can't hire any previously-experienced people to do any of the actual work.

(This exercise is to get you to think about how much there is that we don't generally appreciate about a specialized organization's Human System.)

Notes

H5

READY? YOUR NEW ASSIGNMENT WILL BE TO TAKE OVER AND RUN ONE OF THE FOLLOWING:

- An NFL football team;
- A high-fashion garment design and mfg. co.;
- An orchard in Florida;
- A Bushman camp in the Kalihari desert;
- A semi-conductor factory;
- The city administration of New York;
- A four-star restaurant.

H6

NEXT HUMAN-SYSTEM APPRECIATION EXERCISE – IMPACT ON CURRENT ORGANIZATIONS WHEN:

High-temperature super-conductor devices:

a. Much smaller, more efficient electric generators and motors -- e.g., 100 horsepower in one cubic foot, weighing 50 lbs, and achieving 98% efficiency.

b. A two cu-ft storage battery, weighing 50 lbs, that can store enough electric energy to power your electric car across the U.S.

Notes

H7

NEXT HUMAN-SYSTEM APPRECIATION EXERCISE – IMPACT ON CURRENT ORGANIZATIONS WHEN:

Nano-technology devices: (Engineering with molecules):

Button-sized unit for surgical implantation, getting its power from human-host metabolism;

connecting to conditionable nerve channels for "internal" communication with human host;

providing a gigabyte of memory and 100 MIPS processing power;

with wireless I/O to the outside world.

Notes

H8

NEXT HUMAN-SYSTEM APPRECIATION EXERCISE – IMPACT ON CURRENT ORGANIZATIONS WHEN:

Robotic personal transporters -- safe personal transportation at five times the average speed on our same streets and highways.

OR

Virtual-reality Implementation -- using the implanted, wireless, nano-technology devices to provide virtual-reality stimulus via direct nerve connections.

Notes

Notes

H9

EXAMPLE: CONSIDER A FAMILIAR AUGMENTATION SYSTEM

HUMAN SYSTEM
Laws Regulations Insurance Licensing Rules of the road Traffic patrol "low riding"
Skills Knowledge
Training

TOOL SYSTEM
Automobiles
Roads, Bridges, Freeways, Toll Stations, Rotaries, Traffic lights, Stop signs, Spare tires, Jacks, Chains, Road maps, ...

The automotive transportation system

Notes

H10

CONSIDER REPRESENTATIVE HUMAN SYSTEM ELEMENTS FOR OUR AUTO-TRANSPORT SYSTEM

Organization: Departments of transportation; licensing, insuring and financing institutions; legislating, policing and adjudicating traffic laws; manufacturing; repair and service stations; ...

Procedures: How to shop, buy, finance, insure and license a car; how to become a driver; how to get a car fixed; ...

Conventions: Drive on right, pass on left; give right of way to driver to your right; signal for turn and lane changes; honor pedestrians right of way; ...

Notes

H11

CONSIDER REPRESENTATIVE HUMAN SYSTEM ELEMENTS FOR OUR AUTO-TRANSPORT SYSTEM

Language: Nouns like brake, transmission, accelerator, turn indicator, traffic light, ...; verbs like accelerate, shift, signal, yield, refuel, ...;

Skills: Signal, turn, and decelerate simultaneously; unlock doors, adjust seats, start motor, engage transmission, accelerate smoothly, steer in reverse,...;

Knowledge: When & where to refuel, get new tires renew insurance and license, file a claim; how to learn traffic conditions; routing from A to B; ...

H12

Hypothesis #1: Whole-system Augmentation

Highly-developed work methods must evolve hand in hand with the tools, via exploratory pilot outposts in diverse application areas.

- Appreciating Human-System Contributions
- Human-System Elements of CODIAK Support
- Advanced Exploratory Pilots
- High-Performance Teams
- Conclusion

Notes

*Where CODIAK support is concerned, we estimate that only about 5-10% of the total expense will be in the Tool System. The remaining 90-95% will be in making coordinated advancements in the Human System. This assumes that the Tool System includes an OHS—no OHS would mean **much** higher (wasted) Tool-System expense.*

H13

SOME LIKELY CHANGES IN HUMAN SYSTEM ELEMENTS WITH FUTURE OHS UTILIZATION (1)

Organization: More specialists, coordinating over broader activity domains; new specialty roles, e.g., "issue auditor," "dialog coach," "horizontal domain integrator;" concurrent processes enabling a "multi-dimensional matrix management;"

Conventions: Where you install what kind of flag in the knowledge base to differentiate between twenty kinds of alert about an idea, worry, or supportive argument; or, twelve different kinds of "footnotes" needing consistent notation/portrayal.

Notes

H14

HUMAN-SYSTEM CONSIDERATIONS FOR CODIAK SUPPORT

There is much more to be learned about the rigorous use of an OHS in a wide-area, distributed CODIAK process.

The human-system elements -- all the methods, procedures, conventions, skills, etc. -- must be highly developed in close association with the continuing evolution of OHS requirements.

Notes

Notes

H15

ABOUT CHANGES IN HUMAN SYSTEM ELEMENTS WITH FUTURE OHS UTILIZATION (2)

My intuition strongly predicts very significant differences from today's organizations, at all levels: new roles, very different methods and procedures, wider variety of skills, enterprise-wide practices with timing and coordination undreamed of today.

BUT, my familiarity and understanding of current organizational practices aren't strong enough to give me confidence in making specific predictions.

Sorry. Yet I have complete faith that exploration and collaboration will produce great differences.

Notes

H16

Hypothesis #1: Whole-system Augmentation

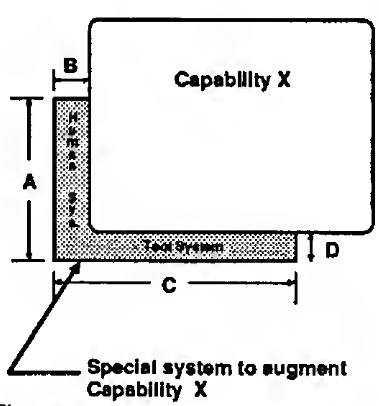
Highly-developed work methods must evolve hand in hand with the tools, via exploratory pilot outposts in diverse application areas.

- Appreciating Human-System Contributions
- Human-System Elements of CODIAK Support
- **Advanced Exploratory Pilots**
- High-Performance Teams
- Conclusion

Notes

H17

TECHNOLOGICALLY ENHANCED AUGMENTATION PROVIDED BY A MULTI-DIMENSIONED SYSTEM



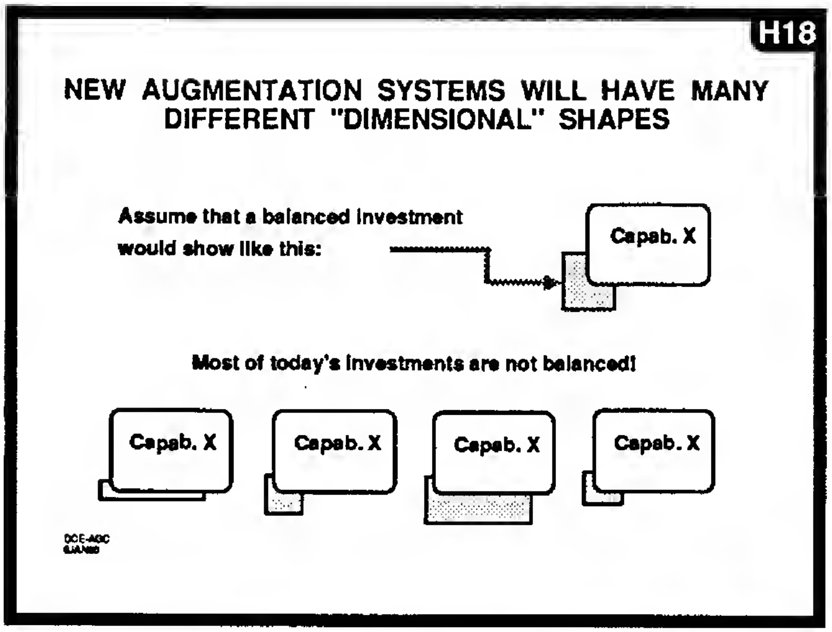
Augmentation-System Dimensionality:

A: Human-System Sophistication

B: Training & Coaching Investment

C: Tool-System Sophistication

D: Tool-System, Per-Person Investment



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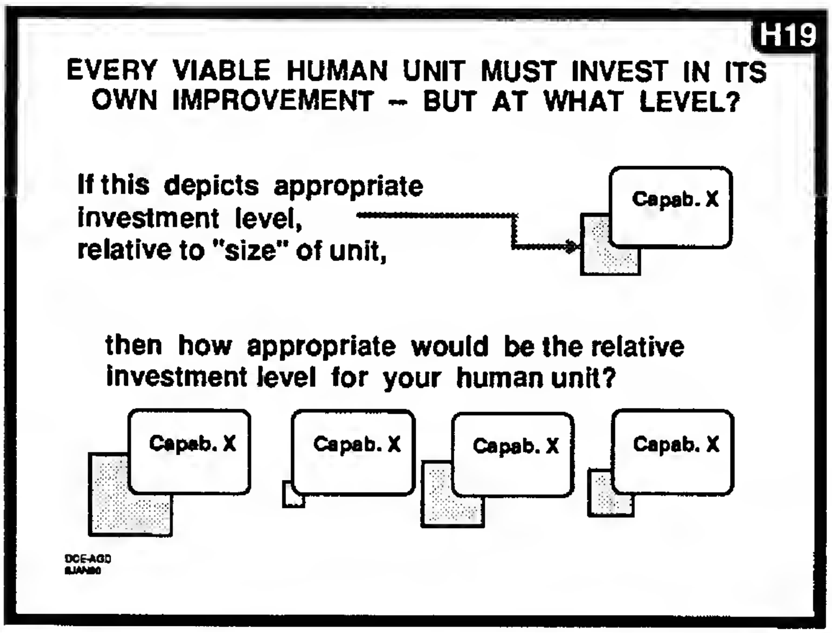

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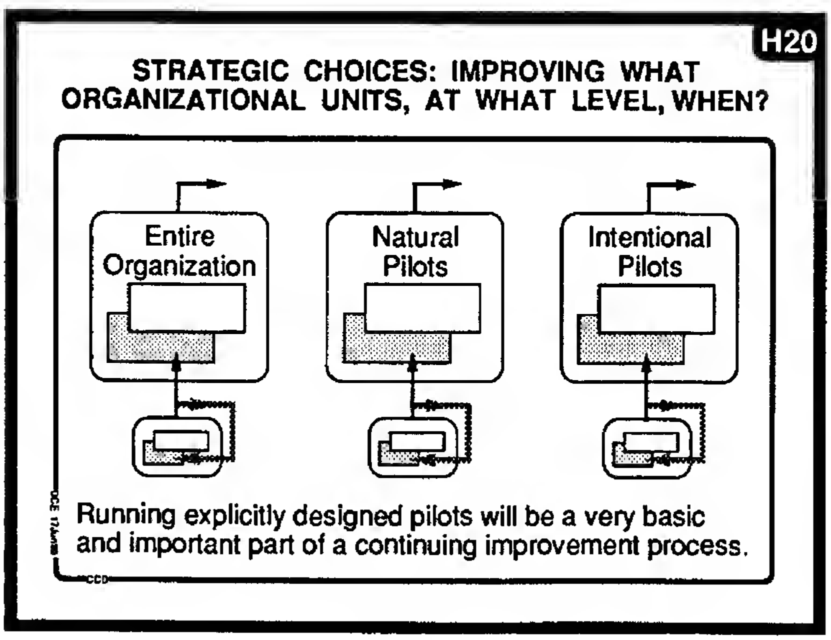


A very important part of B-Activities, when the pace of change is high, will be to plan, implement, support and evaluate a continuous series of pilots.

A very important C-Activity is to improve the B capability for doing just that.

Notes

H21

MANY TYPES OF PILOTS WILL BE NEEDED

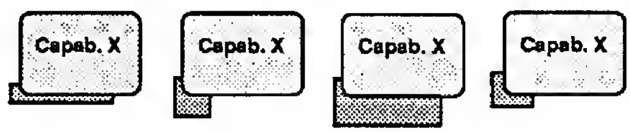
- some for furthering the advanced exploration
- some to give elite project teams the experimental advanced capabilities
- some to give the "regular" workers a "taste" of what's to come

The advanced pilots are an important B-Activity tool for ensuring relevance and human-tool integration, learning how to harness the capabilities for higher-performance, and learning how to deploy them.

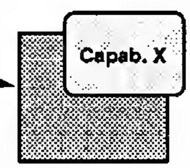
Notes

H22

NEW AUGMENTATION SYSTEMS WILL HAVE MANY DIFFERENT "DIMENSIONAL" SHAPES



Suppose that an important, composite, pilot-team capability was augmented (equipped, trained) like this:

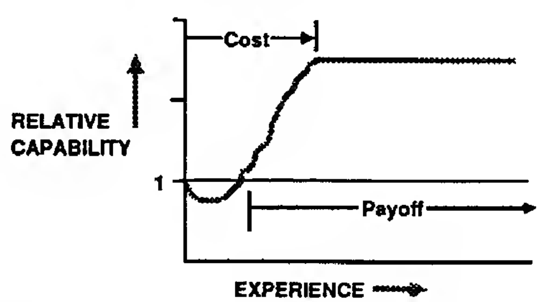


There is an important strategic role for such units.

Notes

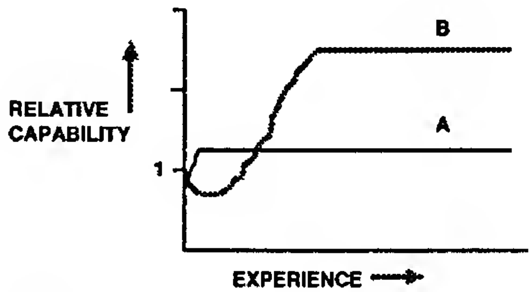
H23

WEIGH THE COST TO DEVELOP A GIVEN PROFICIENCY AGAINST ITS PAYOFF !



H24

WHICH SYSTEM WOULD YOU BUY?
(THE TRICYCLE, OR THE BICYCLE?)



Notes

H25

HUMAN-SYSTEM EVOLUTION NEEDS SUPPORT FOR GRADES OF USER PROFICIENCY!

- Yes, "easy to learn" for beginners; but this will decrease in importance as the user-population continues to mature.
- Evolution will be severely inhibited if experienced, heavy users can not extend their capability with enhanced vocabulary and procedural proficiency.

Notes

H26

Hypothesis #1: **Whole-system Augmentation**

Highly-developed work methods must evolve hand in hand with the tools, via exploratory pilot outposts in diverse application areas.

- **Appreciating Human-System Contributions**
- **Human-System Elements of CODIAK Support**
- **Advanced Exploratory Pilots**
- **High-Performance Teams**
- **Conclusion**

Notes

A very important type of future "intentional pilots" will be for specially recruited, equipped and trained "high-performance teams." Hard to picture any other way to accellerate evolution toward the future high-performance organizations.

H27

PURSUING HIGH-PERFORMANCE AUGMENTATION SHOULD START WITH SMALL GROUPS

Rather than large groups because: shorter evolutionary cycles; more economical scale of experiments; more "cultural mobility."

Rather than individuals because: exploring high-performance augmented collaboration is too promising to be omitted.

"High-Performance Augmented Teams"

Notes

H28

ROLE OF HIGH-PERFORMANCE TEAMS SHOULD TIE CLOSELY TO OUTSIDE WORLD

Important strategic goal: to find economically viable roles for such teams in real-world organizations.

Important strategic goal: to give attitude leaders of the outside world direct experience of the teams' exceptional capabilities.

(Direct experience is the most effective molder of understanding and attitude about new things.)

Notes

H29

EXPERIMENTAL, HIGH-PERFORMANCE TEAMS SHOULD BE EQUIPPED FOR SPECIFIC JOBS

Tools, methods, language, training -- all need to be focussed on a specific kind of application work.

Strategic reasons to aim early exploration at some sort of support work -- and not for an in-line organizational role.

"High-Performance Augmented Support Teams"

H30

A NUMBER OF ROLES MAKE ATTRACTIVE CANDIDATES FOR HIGH-PERFORMANCE TEAMS

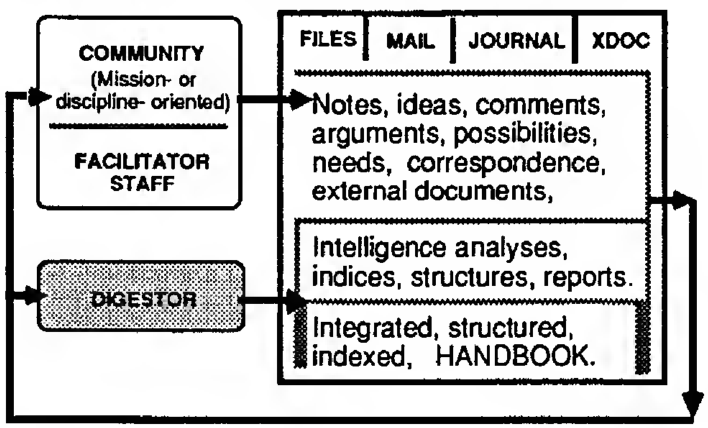
E.g., highly focussed project teams -- especially software development.

Or, a "Digestor" role for a large project or special-interest community -- e.g., to support dialog, analyze the contributions, integrate them into a "project handbook," generate special "portrayals" (e.g., presentations or documents), etc.

Notes

H31

A HIGH-PERFORMANCE "DIGESTOR": ENORMOUS VALUE TO THE HANDBOOK CYCLE



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This is one of two roles for a high-performance support team that have especially high bootstrapping value. This role is a high-priority candidate for implementing and supporting within an early CCom.

H32

ONE EARLY-ROLE CANDIDATE WOULD BE TO SUPPORT WORKING CONFERENCES

Very valuable service. Matches early augmentation possibilities.

Very direct interaction with "outside-world" conferencing people.

Limited duration & cyclic nature allows for de-briefing and system updates.

A new set of particpants each cycle -- more (key) people gaining new perceptions.

This is the other "favorite candidate" role for high-performance support team, to be put to work in CCom activity and in its participatory interactions with others.

It would be hoped that some of those who are already doing meeting-improvement R & D would become participants in CCom activity as a special class of B-Workers.

H33

SPECIAL SERVICES COULD FACILITATE COMMUNITY-RELATED MEETINGS

- Hi-tech "Conference Theatre"
- Multi-media records, inter-linked
- Fast voting, integrated into record
- Specially trained support staff:
  - Near real-time minutes: annotated, linked to multi-media records
  - Very fast location and display of recorded events and references
  - Highly skilled analysis and portrayal of meeting status: net position; unresolved

Notes

H34

Hypothesis #1: Whole-system Augmentation

Highly-developed work methods must evolve hand in hand with the tools, via exploratory pilot outposts in diverse application areas.

- **Appreciating Human-System Contributions**
- **Human-System Elements of CODIAK Support**
- **Advanced Exploratory Pilots**
- **High-Performance Teams**
- **Conclusion**

Notes

H35

CONCLUSION

The OHS tools represent only a small part of the solution.

New, advanced, exploratory pilots will be needed for rapid cultivation of human-tool co-evolution of high-performance capabilities such as CODIAK.

Who will be responsible for this exploratory work? Vendors? End-user organizations? Universities? Government?

I

BOOTSTRAP SEMINAR
Nov 30 – Dec 2, 1992

Foil Set I:

BOOTSTRAPPING —

HIGH-LEVERAGE INVESTMENT STRATEGY FOR ORGANIZATIONAL IMPROVEMENT

Douglas C. Engelbart, Bootstrap Institute

Notes

I1

BASIC BOOTSTRAP CONCEPTS

Objective: Pursue high-performance org
Hypothesis #1: Whole-system Augmentation
Hypothesis #2: ABC's of Org Improvement
Hypothesis #3: Bootstrap Strategy
Hypothesis #4: Collab. Knowledge Work (CODIAK)
Hypothesis #5: Open Hyperdoc System (OHS)
Hypothesis #6: Joining forces in a C Community

(assumes major paradigm shifts throughout)

Notes

I2

Hypothesis #3: Bootstrap Strategy

Early strategic focus on tools and processes that improve both the product cycle and the *improvement cycle* offers *compounded leverage* for bootstrapping organizations into the 21st century.

- Motivating observations
- Going after the improvement capability
- Bootstrapping for compound leverage
- Investment criteria — leveraging group knowledge work (CODIAK) as a core capability
- Conclusion

Notes

Notes

13

Assume that the computer-communications revolution is only in its early stages, and that future changes will be **very pervasive** and **very significant!**

Then a serious future problem for every large organization (business or gov't) becomes how to accomodate **very complex** and **increasingly rapid** changes:

- in the organization's external operating environment;
- in the organization's internal operating environment.

Notes

14

If the scale and pervasiveness of change
is to be as great as seems likely,

then a great deal more attention
will have to be given
to organizational evolution
than we have ever before
considered necessary!

New approaches will be required,
with ample organizational support
at very high levels.

Notes

15

It is likely that many organizations will not adapt quickly enough or appropriately enough to survive these complex and rapid environmental changes.

These rapid environmental changes will be a continuing phenomenon for many decades.

The surviving organizations will likely have established especially energetic and intelligent internal processes to plan and manage their evolution.

Needed: A pragmatic, global, continuing *strategy* for investing in evolutionary improvement

— **The purpose of the *Bootstrap Strategy.***

16

Hypothesis #3: Bootstrap Strategy

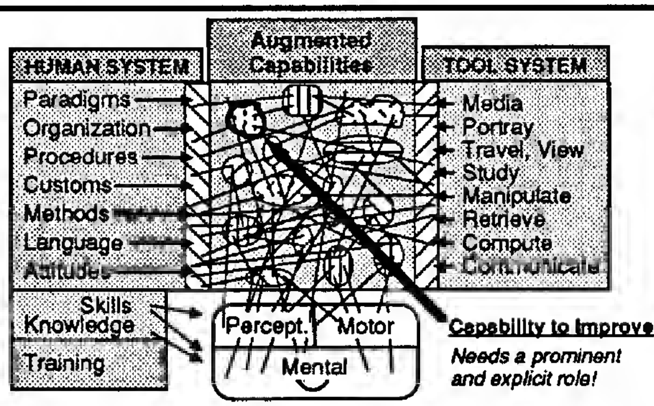
Early strategic focus on tools and processes that improve both the product cycle and the *improvement cycle* offers *compounded leverage* for bootstrapping organizations into the 21st century.

- **Motivating observations**
- **Going after the improvement capability**
- **Bootstrapping for compound leverage**
- **Investment criteria — leveraging group knowledge work (CODIAK) as a core capability**
- **Conclusion**

Notes

17

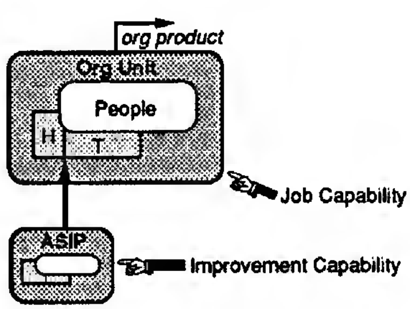
EVERY ORGANIZATION NEEDS AN EVOLUTIONARY CAPABILITY!



(From A5 & C28)

18

IMPROVE YOUR ORGANIZATION BY IMPROVING ITS AUGMENTATION SYSTEM



Augmentation System Improvement Project ("ASIP")

Introducing a generic label for an organizational activity that is charged with improving the augmentation system (improving the capability) of another org activity.

In the ABC Model, B is A's ASIP, and C is B's ASIP.

For a well-developed Bootstrap Strategy, there will be many ways to shape the over-all improvement process so as to create and capitalize upon options of this sort.

I9

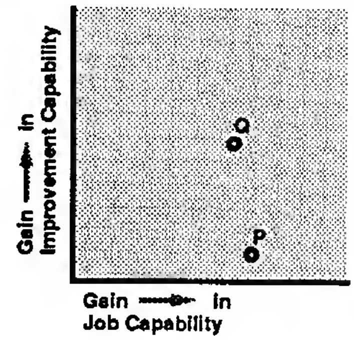
STRATEGIC INVESTMENT LEVERAGE — BOOSTING BOTH JOB AND EVOLUTIONARY CAPABILITIES

The essence of *Bootstrapping*:

Suppose for the same cost you have two options for improving your augmentation system.

Investment Q yields a leveraged, compound return.

The bootstrap strategy searches for such choices in planning improvement investments.

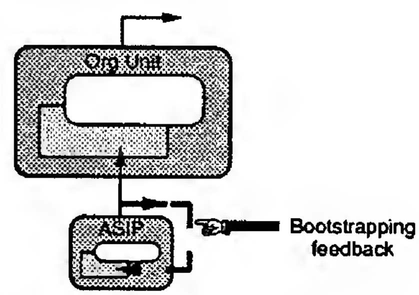


This is an engineer's way of showing the effect of the vertical component in the I9 chart — that the product of the ASIP's work (improvements for its client's augmentation system) are suitable to a significant extent to be installed in its own augmentation system.

Regarding elevating its capability to do its job, the ASIP is "lifting itself up by its bootstraps."

I10

ASIP WITH BOOTSTRAP LEVERAGE



Generating improved capabilities for the org unit that also are integrated into the ASIP process to improve its capability

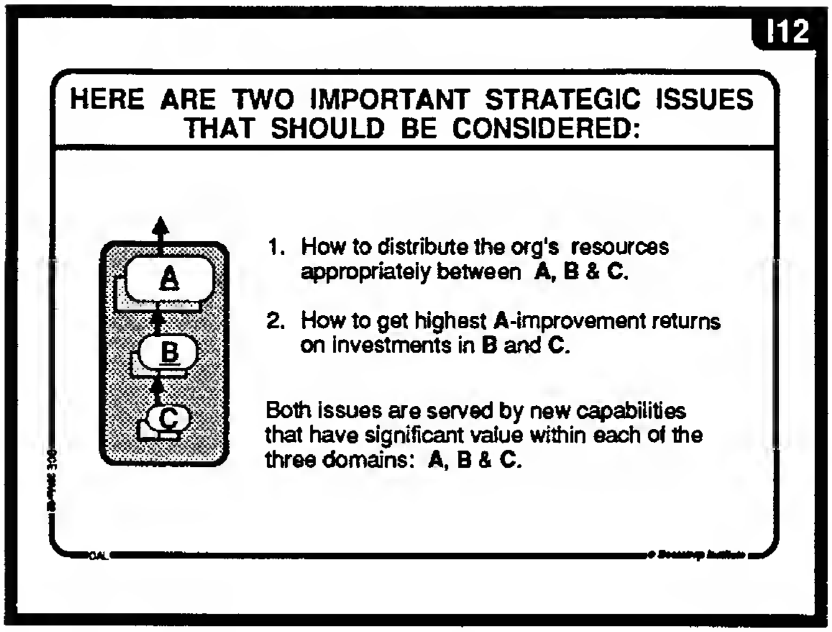
Notes

I11

Hypothesis #3: Bootstrap Strategy

Early strategic focus on tools and processes that improve both the product cycle and the *improvement cycle* offers *compounded leverage* for bootstrapping organizations into the 21st century.

- **Motivating observations**
- **Going after the improvement capability**
- **Bootstrapping for compound leverage**
- **Investment criteria — leveraging group knowledge work (CODIAK) as a core capability**
- **Conclusion**

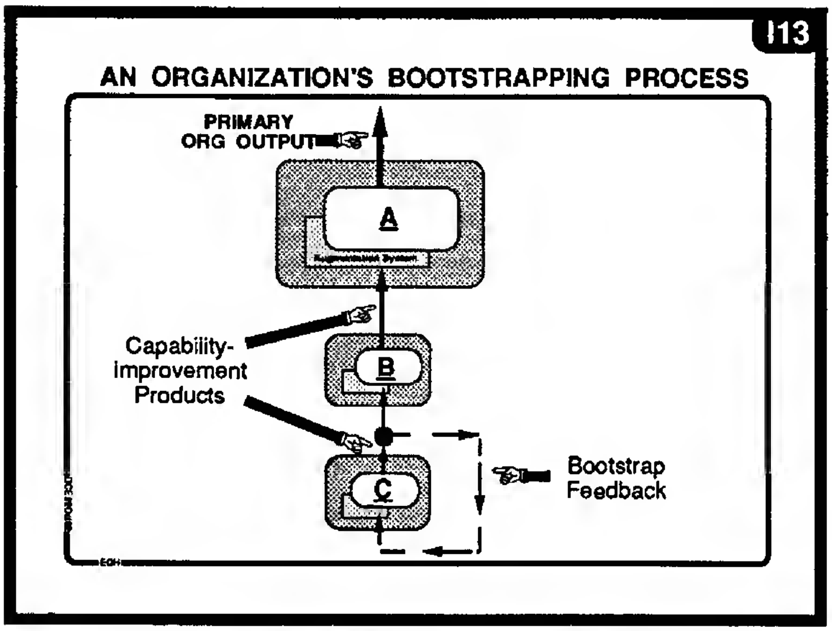


(Same as D19)

"Bootstrapping" is a strategic approach to the continuous evolutionary improvement of organizations.

The idea is to get maximum long-term return on the improvement investments.

Foil D19 poses the investment-strategy question in terms of the A-B-C model and presents the essence of the bootstrapping concept.



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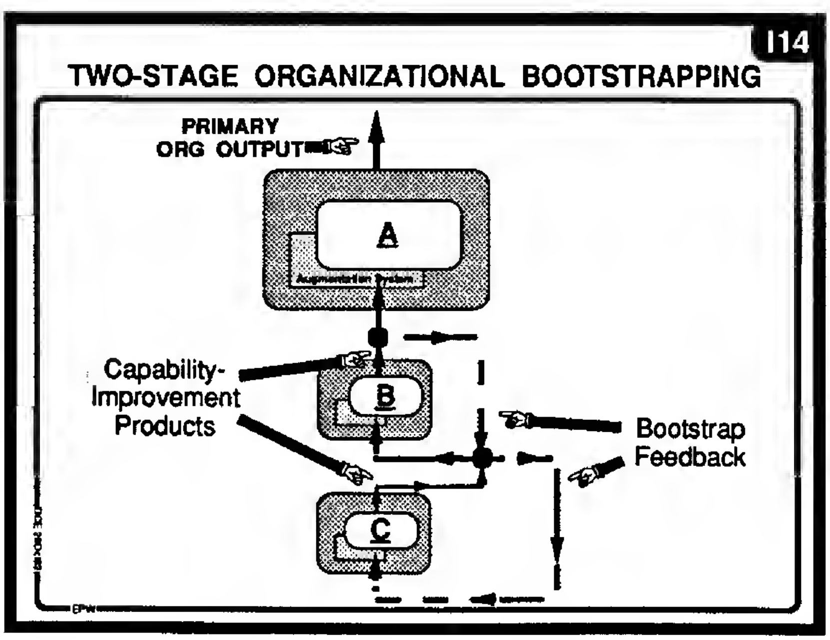
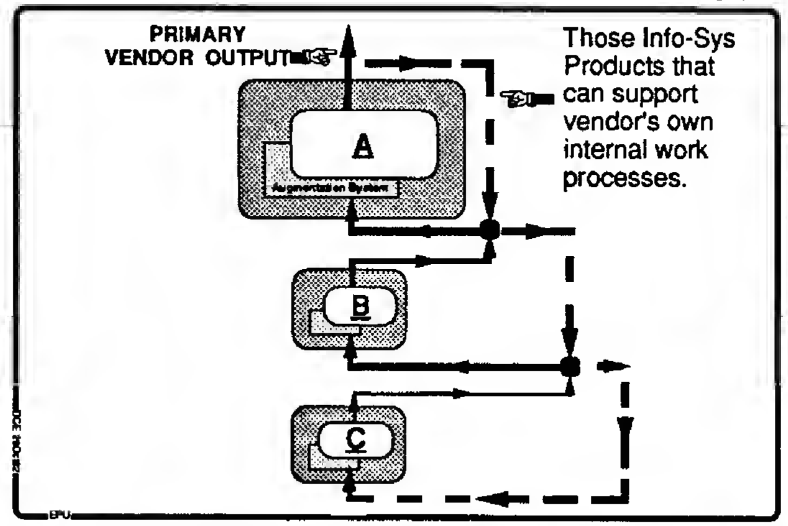


Notes

Notes

I15

AN INFO-SYS VENDOR'S BOOTSTRAP LEVERAGE



(From A7)

Notes

I16

BOOTSTRAPPING STRATEGY

Improvement Return on Investment (ROI) —

On A Activity: Step increment
On B Activity: 1st derivative
On C Activity: 2nd derivative

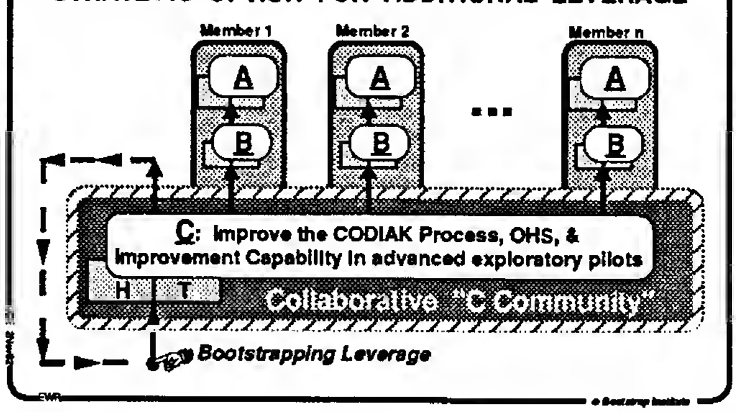
(From A11 & D23)

This presented a strategic option that, while not in itself an example of bootstrapping, sets the stage for developing the basic components of the bootstrap strategy.

Note that the member "org units" could be small functional units within a division, or divisions within a company (within which are communities of small units) — or independent organizations in a cooperative community.

I17

SIMILARITIES AMONG *C ACTIVITIES* OPENS STRATEGIC OPTION FOR ADDITIONAL LEVERAGE



I18

Hypothesis #3: Bootstrap Strategy

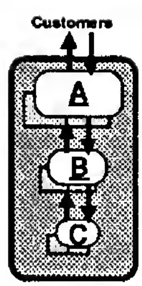
Early strategic focus on tools and processes that improve both the product cycle and the *improvement cycle* offers *compounded leverage* for bootstrapping organizations into the 21st century.

- **Motivating observations**
- **Going after the improvement capability**
- **Bootstrapping for compound leverage**
- **Investment criteria — leveraging group knowledge work (CODIAK) as a core capability**
- **Conclusion**

Notes

I19

BOOTSTRAPPING: STRATEGIC INVESTMENT CRITERIA



Selecting capabilities for **C** to improve that serve **A** and **C**, as well as **B**, offers special investment leverage. Start with these 3 most-basic capabilities:

1. doing group knowledge work;
2. transfer results "up the line" to respective "customers" (↑);
3. integrate information coming "down the line" from respective "customers" (↓).

(note that capabilities 2 and 3 depend on 1)

← (Same as D20 & E3)

This provides a very solid entry into the whole story of the bootstrap strategy — and also directly sets the stage for the "Bootstrap Launch" approach developed in Section L of this binder.

We'll outline below the approach to augmenting the CCom's group work and transfer processes, employing selected augmented capabilities that are also direct candidates to improve both B and A.

I20

THIS EMERGES AS THE HIGHEST-LEVERAGE BASIC ORGANIZATIONAL CAPABILITY

The CОncurrent Development, Integration, and Application of Knowledge ***(CODIAK)***

Developing an evolving knowledge base that integrates the concurrent contributions of many distributed participants, operating from the many (nested) knowledge domains involved within and among our enterprises, and concurrently supporting their application of the included knowledge.

← (Same as E8)

Since the concept of a bootstrapping strategy for augmenting organizational capability first emerged in 1961, this core capability has consistently out-pointed every other candidate for being the "bootstrap launching target."

Notes

I21

Hypothesis #3: Bootstrap Strategy

Early strategic focus on tools and processes that improve both the product cycle and the *improvement cycle* offers *compounded leverage* for bootstrapping organizations into the 21st century.

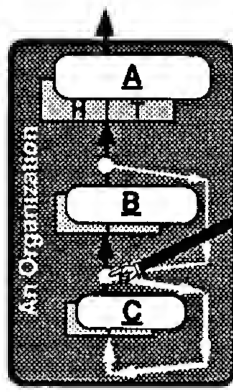
- **Motivating observations**
- **Going after the improvement capability**
- **Bootstrapping for compound leverage**
- **Investment criteria — leveraging group knowledge work (CODIAK) as a core capability**
- **Conclusion**

Notes

(Same as A7)

I22

EXTRA BOOTSTRAPPING LEVERAGE



Investment criteria:

Going after the point of greatest leverage — a high-performance knowledge-work capability launched by **C** boosts **C**, **B**, and **A** with compounded leverage.

Notes

J

BOOTSTRAP SEMINAR
Nov 30 - Dec 2, 1992

Foil Set J:

C COMMUNITY —

JOINING FORCES TO LAUNCH BOOTSTRAPPING

Douglas C. Engelbart, Bootstrap Institute

Keep in mind here the gathering of prior concepts in the preceding Section I, and their integration into the strategic purpose and value in launching a "Bootstrap Strategy."

J1

BASIC BOOTSTRAP CONCEPTS

Objective: Pursue high-performance org
Hypothesis #1: Whole-system Augmentation
Hypothesis #2: ABC's of Org Improvement
Hypothesis #3: Bootstrap Strategy
Hypothesis #4: Collab. Knowledge Work (CODIAK)
Hypothesis #5: Open Hyperdoc System (OHS)
Hypothesis #6: Joining forces in a C Community

(assumes major paradigm shifts throughout)

Notes

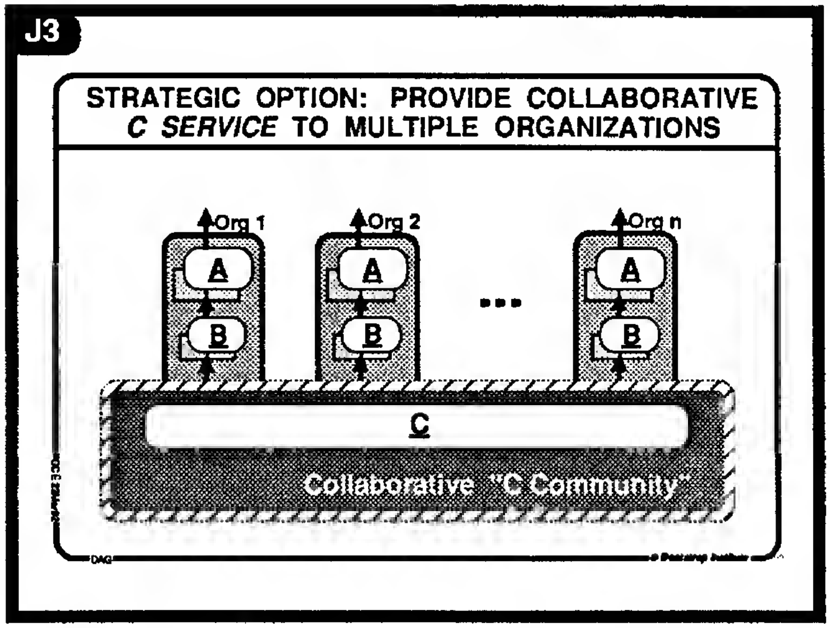
J2

Hypothesis #6: Joining forces in a C Community

A productive, continuing C Community is at the heart of any high-payoff bootstrapping strategy. It also provides a cost-effective, high-leverage entry point into bootstrapping.

- Basic C Community Concepts
- C Community's CODIAK Process
- CODIAK Scale and Scope
- Extended C Community Concepts
- Bootstrapping Your Organization
- Conclusion

Notes



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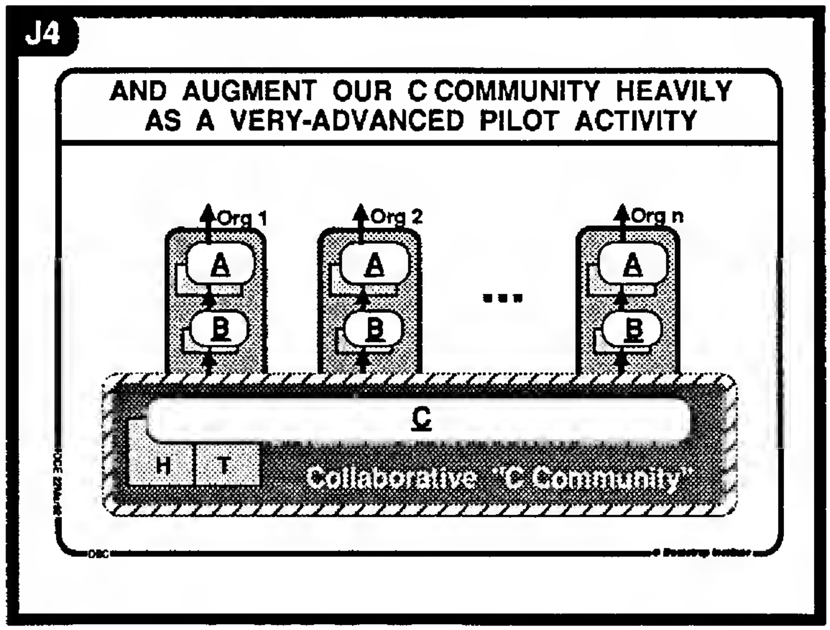
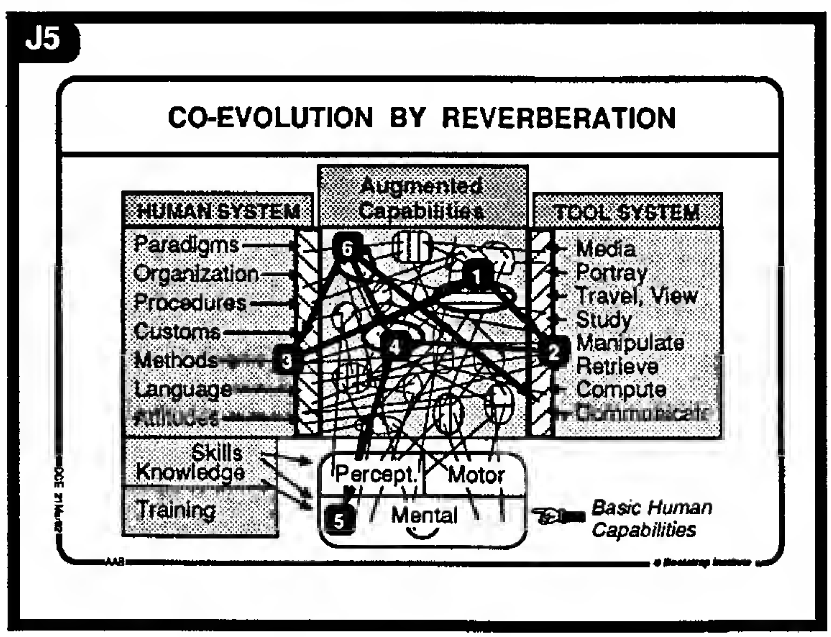


Notes

(Same as C15)



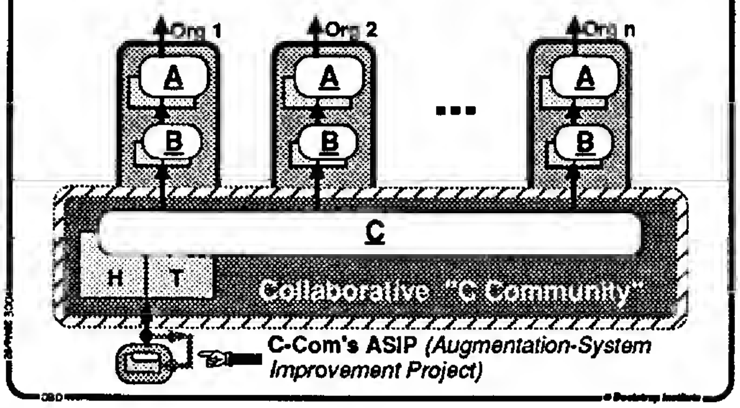
Reminder: Principle of improvement by co-evolution among the interdependent parts of the whole augmentation system.

The "stakeholders" associated with interdependently co-evolving capability nodes often are not in same line-management structure — often more of a "community.

"This brings out the basic, bootstrapping importance of augmenting distributed communities of cooperative stakeholders.

J6

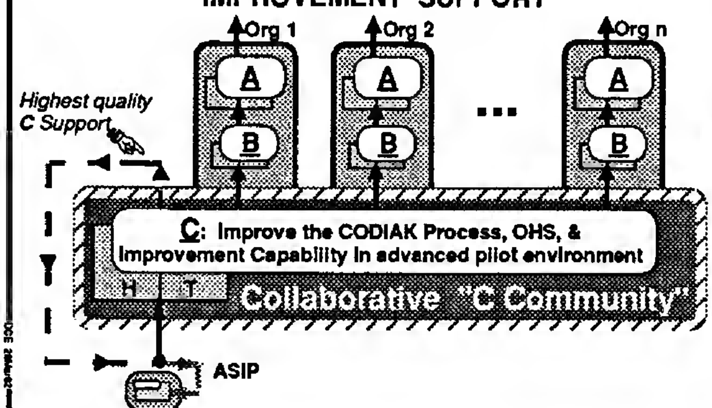
KEY INGREDIENT: CONTINUING IMPROVEMENT OF C-COM'S CODIAK CAPABILITY



Remember, CODIAK is the "COncurrent Development, Integration, and Application of Knowledge."

J7

THE C-COM ASIP OF COURSE NEEDS IMPROVEMENT SUPPORT



Notes

J8

***Hypothesis #6:* Joining forces in a C Community**

A productive, continuing **C** Community is at the heart of any high-payoff bootstrapping strategy. It also provides a cost-effective, high-leverage entry point into bootstrapping.

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- **C Community's CODIAK Process**
- **CODIAK Scale and Scope**
- **Extended C Community Concepts**
- **Bootstrapping Your Organization**
- **Conclusion**

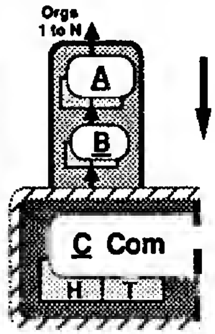
Notes

An effective CODIAK process is especially useful in importing external intelligence, chewing it well with recorded dialog among relevant parties, and digesting the lot into integrated reference bases and focused handbooks.

J9

CORE C-COM CAPABILITY

To integrate, analyze, and portray multiple-source contributions to its knowledge base:



From their B & A activities: *Lessons learned, requirements, design dialog, needs & possibilities, ...*

From External Environment: *trends, products, trials, theories, events -- Intelligence.*

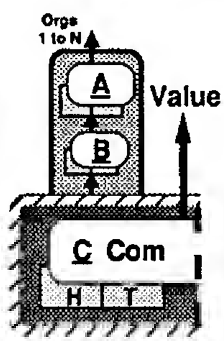
Internal CCom: *Lessons learned, needs & possibilities, design, ...*

Exploratory pilots will be a must; the more experience an organization can gain, and the more advanced and comprehensive the pilots from which that experience is gained, the better it will be able to plan, motivate and implement its improvement investments.

Early target: to transfer into B the capabilities to (a) access CCom's CIC and Handbooks. and (b) partake in CCom's recorded dialog. Bootstrapping an improved, bilateral "Transfer."

J10

PARTNER ORGS GET UNIQUE VALUE FROM FUTURE-MODE C-COM ACCESS AND DIALOG



1. Direct experience with an advanced pilot activity -- which is doing intensive, real work that the Partner Orgs guide toward maximum value to them.
2. Direct, online access to **CCom** knowledge products
3. Continuous dialog to enrich the pilot experience and transfer **CCom** knowledge products.

Here we outlined the basic components of C-Com's CODIAK process.

From prior sections of this binder, it should be clear that this is a very basic and ubiquitous group-work process .

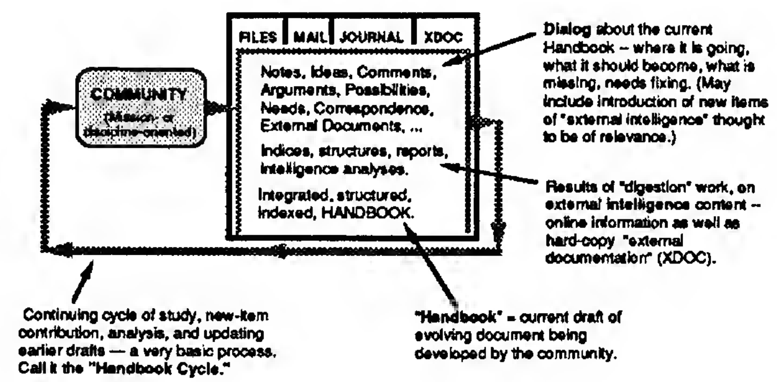
J11

SPECIAL BOOTSTRAPPING FOCUS: IMPROVING THE C-COM'S CODIAK CAPABILITY

- **Recorded Dialog**: *highly collaborative, within an open hyperdocument system* — integrated with E-mail, shared files, and permanent, cataloged "library" system, as well as with CIC and Handbook.
- **Community Intelligence Collection** (CIC): *in highly useable, hyperdocument form* — integrated with recorded dialog and Handbook.
- **Community Handbook**: *a dynamically evolving hyper-document "collaborative-knowledge product"* — integrated with recorded dialog and CIC.

J12

AN OHS SHOULD SUPPORT NOT ONLY REFERENCE ACCESS, BUT ALSO DYNAMIC EVOLUTION OF THE HANDBOOK



DCE-CCC4
28Oct92

(Same as F57)

Sections F and G developed a basic approach for augmenting the CODIAK process for a distributed community.

Future availability of something like a globally useable OHS will be critical.

Early, prototypical "OHS" capability will be very valuable in B and C activities, contributing significantly to the bootstrapping leverage.

OHS for A work: hi-priority for B & C!

J13

Hypothesis #6: Joining forces in a C Community

A productive, continuing **C** Community is at the heart of any high-payoff bootstrapping strategy. It also provides a cost-effective, high-leverage entry point into bootstrapping.

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- **Extended C Community Concepts**
- **Bootstrapping Your Organization**
- **Conclusion**

EWW — Bootstrap Institute

Notes

J14

WITH INTERLINKED CUSTOMERS AND SUPPLIERS, NO MAJOR INDUSTRY CAN AFFORD ISLANDS

A whole industry, with many inter-operating organizational units, is in itself an *"organization"* that has a functional *"augmentation system"* whose improvement warrants explicit evolutionary attention.

The "A Activity" of this organization will very much need a global OHS. Early prototypical OHS capability for its **C** and then **B** Activities would thus be an immediate bootstrapping priority.

EPM — Bootstrap Institute

(Same as E30)

And extending this reasoning brings us to the staggering challenge of implementing high CODIAK capability on a global scale.

Notes

J15

WHAT SCALE TO TRY FOR?

Toward what size and importance for the target applications of direct CODIAK improvement?

How wide and deep on each "cut" of improvement?

How rapidly to move forward?

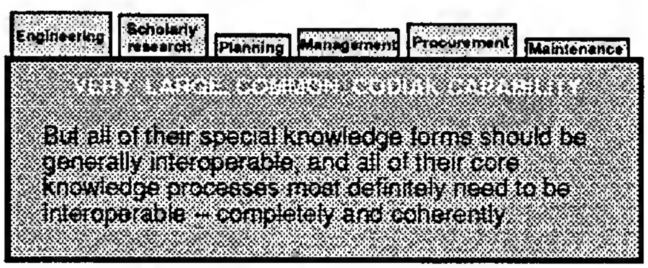
The special-domain list is endless—government at all levels, all business and industry, every institution, every facet of daily life.

*In the short run, it is far easier for the marketplace to keep investing in isolated, large-system point solutions. But the CODIAK capability is extremely general, and will inevitably be supported by a **generic solution** where the subset of special features within each special domain will be surprisingly small. Going after such a general solution sooner will be **much** more **cost-effective** than the point-solution alternative, and should yield much **higher leverage** in productivity and performance.*

J16

COMMON CODIAK PROCESSES UNDERLY THE SPECIAL ONES OF ANY KNOWLEDGE DOMAIN

Each adds its own special knowledge forms, conventions, tools, etc. -- all of which must be built and operated atop the common CODIAK core.



Notes

Especially an OHS →

J17

AUGMENTING THE CODIAK PROCESS

- Open-system, integrated architectures are of critical concern, supporting and spanning across:
  - many different classes of workers
  - many different workstations and application domains
  - organizational units, offices, and organizations
- Exploration must go beyond technology to include associated work methods and organizational structures.
- Exploration must go beyond R&D to include pilots, and strategic deployment within rapidly changing organizations.

J18

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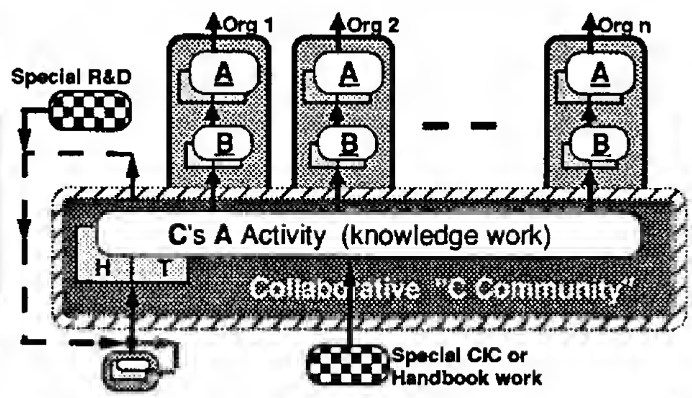
- **Extended C Community Concepts**
- **Bootstrapping <u>Your</u> Organization**
- **Conclusion**

Notes

J19

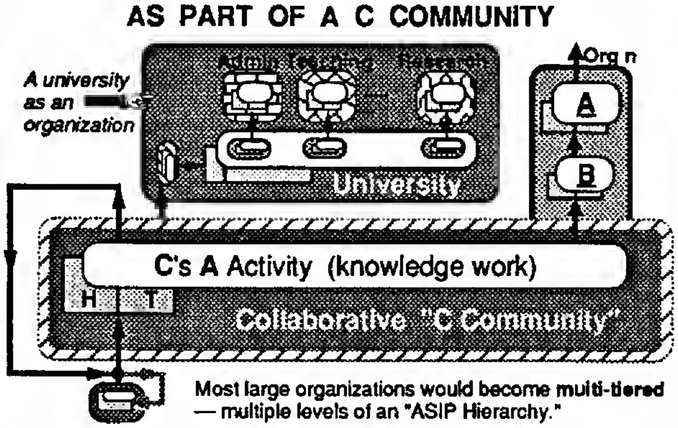
C-COM CAN BUY SPECIAL SUPPORT FROM UNIVERSITIES AND CONSULTANTS



Notes

J20

POTENTIAL UNIVERSITY ACTIVITIES AS PART OF A C COMMUNITY



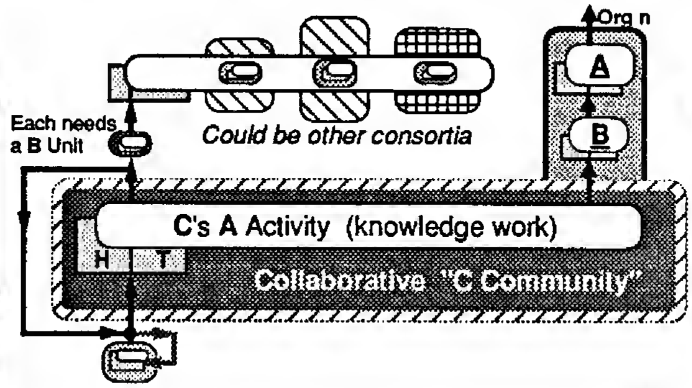
Most large organizations would become multi-tiered — multiple levels of an "ASIP Hierarchy."

Notes

Notes

J21

OTHER SPECIAL-INTEREST COMMUNITIES COULD BECOME C-COM "PARTNER ORGANIZATIONS"



Notes

J22

OTHER CONSORTIA COULD BENEFIT FROM MEMBERSHIP IN THIS C COMMUNITY

This C Community is designed to be a prototype for employing tomorrow's CODIAK capability to operate a cooperative community -- improving management, governance, substantive work, and transfer of results.

Some of the larger, critical consortia could well be the most active members -- not only increasing their effectiveness as consortia, but also very usefully extending pursuit of CODIAK improvement out to their members.

(Note what Werner and Bremer have to say.)

A bootstrapping C Community will score very high on all 5 points.

J23

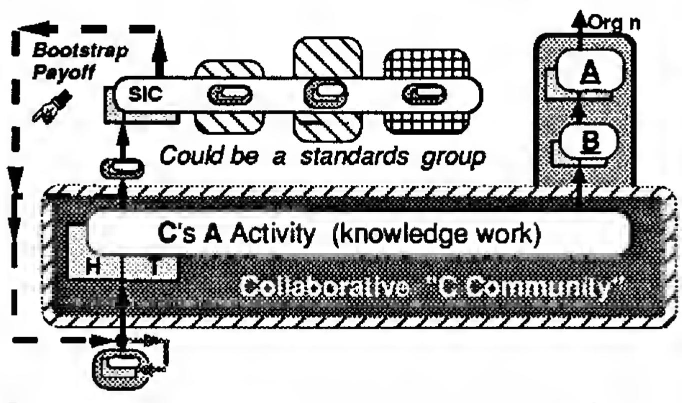
TOWARD BUILDING A BETTER CONSORTIUM FIVE POINTS BY WERNER & BREMER

1. Maintain a coherent vision.
2. Choose research problems that have significant payoffs.
3. Optimize communications with members.
4. Make technology transfer a continual process.
5. Strengthen membership commitment.

"Hard Lessons In Cooperative Research," Issues in Science and Technology, Spring, 1991, pp. 44-49.

J24

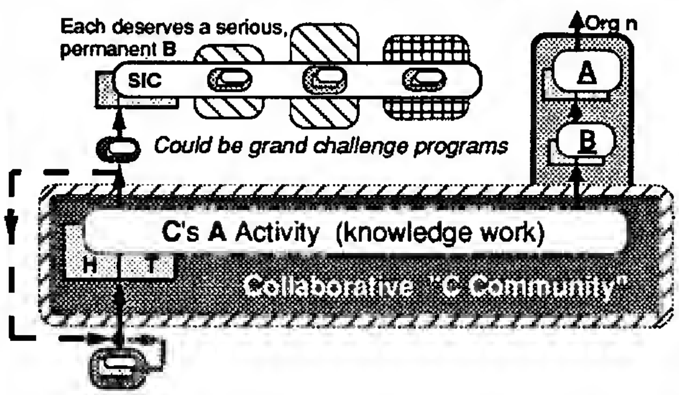
BOOTSTRAP PAYOFF WHEN A SIC'S SPECIAL INTEREST CONTRIBUTES TO C-COM MISSION



Notes

J25

NATIONAL GRAND-CHALLENGE PROGRAMS COULD BE SPECIAL-INTEREST COMMUNITIES



Notes

J26

Hypothesis #6: **Joining forces in a C Community**

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- **Conclusion**

Notes

Notes

J27

LET'S MAKE IT WORK FOR YOU

Bootstrap Institute will work with you to:

- co-develop the vision, content, approach
- integrate strategies into Launch Plan
- launch "Phase 1" to:
  - . experience advanced CODIAK process
  - . develop OHS Procurement Plan
  - . develop plan for multi-year Program

(see Prototype Launch Plan in Section L for details)

Notes

J28

INITIAL LAUNCH STEPS

1. Establish "C Central" *(ideally at corp.)*
2. Identify participating organizational units
3. Form C-Community Board of Directors *("Executive Liaisons")*
4. Finalize basic launch plans
5. Assemble C-Community Work Team *(full-time "Interns" from member org units)*
6. Go operational on selected OHS-1 (develop appropriate staff support)

Notes

J29

PHASE-1 CONTENT

1. CODIAK Framework
2. An OHS research prototype:
   - OHS-1 pilot exploration
   - OHS-2 Implementation Plan
   - OHS-2 requirements
   - Implications for industry standards
3. Methods for *online* CODIAK
4. Deployment strategies
5. Special application areas (e.g. CASE, CE)
6. Bootstrap Strategy

J30

PHASE-1 GENERAL APPROACH

1. Active stakeholder participation
2. Advanced-pilot CODIAK support
3. Detailed scenarios of future pilots
4. Lessons learned from Phase-1 pilot
5. Ongoing surveys, intelligence collection
6. Ongoing recorded dialog
7. Explicit strategy for results transfer
8. Framework for strategic investment

(maximizes relevance, applicability, transferability)

Notes

J31

PHASE-1 DELIVERABLES

Reports, briefings, demos

Operational
- Advanced pilot environ
  - . prototype software
  - . prototype methods
  - . transfer methodologies
- Internship Program
  - . unique pilot experience
  - . intensive training
  - . interns produce results
  - . interns represent A & B
  - . interns transfer results

Knowledge Products
- Multi-year Program Plan
- OHS-2 Implementation Plan
- OHS-2 requirements/specs
- Methods requirements/specs
- Deployment strategies
- Strategic vision
- CODIAK framework
- Application scenarios
- Extensive intelligence base
- Recorded dialog
- Lessons learned
- Recommended standards

(All knowledge products in online hyperdoc form)

Notes

J32

MULTI-YEAR FOLLOW-ON PROGRAM

- develop / procure OHS-2
- plan and launch pilots in participating org units
- continue human/tool co-evolution work
- continue study and application of Bootstrap Strategy
- join forces with other C Communities
- work with standards groups

Toward "Market-driven Quality" within each of the A, B, & C Activities for their respective "Customers" — improving both product cycle end improvement cycle!

Notes

Notes

J33

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- **Conclusion**

An important strategic fallout of this early C Community is to spur the establishment of many other specially deployed communities, to provide similar services in collaboration with selected participating org units.

In particular, CCom's own Partner Orgs can deploy such communities internally to support their improvement projects -- perhaps a hierarchy of such communities in larger organizations.

J34

THERE ARE THREE IMPORTANT TARGETS FOR THE BOOTSTRAPPING C-COMMUNITY

1. To become the advanced prototype of a new, "augmented" breed of distributed, collaborative, special-interest communities and projects.
2. In particular, to become an advanced prototype for communities whose special purpose is to support serious, long-term, organizational improvement programs.
3. To provide the highest possible return to its client organizations in terms of accelerated improvement of their whole-organization improvement capability.

Notes

J35

IS THIS BOOTSTRAP THING A FAR-OUT GAMBLE?

The real question at this point has to do with payoff and risk in the CODIAK challenge.

And the answer is too important to let hang.

The "Bootstrap thing" is oriented to go after that answer as effectively as possible.

J36

In a world whose complexities and urgencies already seem unsolvable, if not incomprehensible, think about what each year's delay may cost us if this hypotheses proves even reasonably true!

Notes

J37

The Bootstrap Strategy is based upon the hypothesis that the constructive capabilities of individuals and their organizations can be further augmented to much higher levels than we experience today.

The Bootstrap Strategy offers a pragmatic way to check that out.

What are we waiting for?

Notes

Notes

AUGMENT'S SUPPORT OF ORGANIZATIONS
A BRIEF HISTORY

Duane L. Stone
Document #: (AUGMENT,132615,)
May 1991

This document contains a quick look at applications within three DoD organizations and how they affected the evolution of NLS/AUGMENT. The dates are from memory and may be off in some cases by a year or two, but the intent is to highlight organizations that had (or tried to have) an influence on the system's development toward supporting organizations. 1

Background 2

The basic system was developed and evolved in the mid-to-late 60s through exclusive use by the development team in the Augmentation Research Center (ARC) at Stanford Research Institute (SRI). With the development of appropriate procedures and training, the goal was to significantly boost individual's, group's and organization's performance (somewhat in that order) by augmenting their ability to work with knowledge. Substantial progress was made in supporting individuals — most of the capabilities and features that now fall under "personal computing" were first reduced to practice within the ARC. Some progress was made toward basic "groupware" or computer supported collaborative work "CSCW" functions — electronic mail, a library system, real-time multi-party shared screen, as examples, were designed or implemented before the system was generally available to outsiders. See <131520,2:xb> for a list of features and capabilities. 2a

However, little progress was made in supporting organizations due (in part) to the inaccessibility of the laboratory at the ARC by the outside world. The development of the TENEX timesharing operating system and hardware pager for the DEC PDP-10 and the first digital packet-switched network (ARPANET) in the early 70s provided an opportunity to take the next step in the human/system co-evoluion by cultivating its use in "real world" organizations. 2b

A series of display workstations were also developed during the 70's to support system use outside of the ARC. Each was based on commercially available equipment, modified with soft/firm/hard ware to meet an evolving set of workstation protocols. With the advent of the personal computer in the 80s, the protocols were implemented entirely in software on the IBM-PC. All versions supported attached mouse, keyset, printer, graphics workstation and a communications line. The approximate years when the various versions were available were: 2c

72-75 — IMLAC Graphics Computer 2c1

74-76 — ARC blue-box called a "lineprocessor" 2c2

75-80 — Data Media 2500 2c3

79-83 — Ontel 2c4

82- — IBM-PC 2c5

There were a number of early sponsor/user organizations, including Defense Advanced Research Projects Agency (DARPA), the National Science Foundation (NSF), and the Air Force at Rome Air Development Center (RADC) and also at Gunter Air Force Station. Later the Army became the dominant user, to include the Army Material Command (AMC) Hqs in Virginia, and several of its subordinate commands — Communications-Electronics in New Jersey, Testing and Evaluation in Maryland, and Aviation Systems, Troop Support and Logistics Management in Missouri. Later as the Army migrated to UNIX-based software, the Air Force Communications Command (AFCC) Hqs in Illinois emerged as the principle user organization. 2d

During the mid 70s a Workshop Utility Service was operated by the ARC and made available via the ARPANET. An active community of architects from each major user organization was formed and met twice a year to provide input on their needs and desires. Still, the high cost of computing power and communications via the ARPANET prohibited extensive use by most organizations. 2d1

In 1978 Tymshare acquired the rights to the software and renamed it AUGMENT. The system entered a phase of commercialization and also became accessible via Tymnet. By the early 80s Tymshare was manufacturing their own mini-computers and on-site installation of complete systems (hardware, software, communications, workstations, training, applications consulting) was being offered. At the peak, there were approximately 15 machines in operation serving a user population of several thousand people. 2d2

In 1984 McDonnell Douglas (MDC) acquired Tymshare (primarily for Tymnet), but had no interest in the office-automation market. The hardware/software/service product-line died from general mismanagement and lack of vision at MDC. However it took 6 years to do so, and during that time several hundred people at MDC and in their partner/supplier companies were exposed to the system during a series of pilot projects. Many of the underlying principles found their way into MDC advanced architecture planning documents. 2d3

It must be remembered that there were two major trends in the office systems area that ran counter to (and subsequently diverted attention from and delayed the acceptance of) the larger-picture view of "organizational computing." 2e

In the 70s it was the stand-alone word processor (that eventually added arithmetic and publishing features and evolved into "shared logic" machines). 2e1

In the 80s it was the personal computer (which, with the right software, obviated the need for a separate word processor) but which are now being networked to each other, to "servers" and to wide area networks. 2e2

After a twenty-year detour, the world may now be ready to seriously address the issues of organizational computing that Engelbart and his team seemed poised to tackle back in the early 70s. There were, however, a few organizations along the way that made begin-ing probes in that direction. 2f

RADC, mid '70s 3

After passively acting as contract monitor of the SRI/ARC effort in the late 60s, RADC established a research project to assess the potential of the system to support Air Force R&D operations. Following the example of the ARC, it was decided that Air Force (civilian and military) engineers, administrators, and managers would be the subjects of an extended pilot. 3a

The early 70's were spent in first accessing the system via teleprinter terminals and long-distance dialing, then installation of an ARPANET node on-site. To prepare the organization for the technology infusion that was to come, the latest in office equipment was installed; IBM Magnetic Tape Selectric Typewriters and Dictaphones! 3b

The system was used initially by individuals and small teams for tasks that would be supported today by applications such as: "word processing" "spreadsheet" "desktop publishing" and "electronic mail." But as the usage grew from the bottom-up to include a Section, then to the higher-level Branch and Division offices, it became clear that the existing general-purpose text processing facilities did not meet the organization's needs. 3c

Much of RADC's R&D is actually accomplished by contract, therefore a substantial portion of the knowledge work is centered around what DoD calls the Planning, Programming, Budgeting, and Execution cycle, i.e., figuring out what should be done, asking for the funds to do it, allocating the funds received, and contracting/monitoring/reporting the R&D effort — all within a continually changing political, economic, technical and regulatory environment. To support this activity, it was necessary to build: 3d

Formatter— a subsystem to help create and print official correspondence in the prescribed format. 3d1

Template/Fill- subsystems to support the on-line construction, filling and completion of "forms" where the information in the form might come from the user, a designated location in a file, or calculations made on other fields. 3d2

FMS/DES — Financial Management and companion Data Entry subsystems that performed a "data management" function associating people, dollars, time, and contracts within a hierarchical structure of technical planning objectives. It allowed managers to track expenditure of resources, play "what if" games with the resources, and let individual project and task engineers see how their work fit with others. 3d3

Calendar— a subsystem to assist in determining people's availability, and subsequently scheduling meetings and notifying participants. 3d4

Correspondence— a subsystem to log and track the correspondence that came into the RADC Commander's office. Used to determine when a response was due and by whom and if the due-date was met. 3d5

Matcher- a subsystem for determining the changes in a document from one version to the next; including statement deletions, additions, movements as well as textual changes within a statement. 3d6

ALMSA, late 70's 4

The system was used by a system development team within the Automated Logistics Management Systems Agency (ALMSA) with a mission to support program management people throughout the Army Material Command (AMC) — also called DARCOM. A "program manager" might have an annual budget from $10 to $100 million, so it seemed well worth the effort to try to improve the program manager's capability. The project had two constraints that had not previously been encountered; 1) the system was to be used from portable teleprinter terminals and 2) by higher-level people who could not be expected to spend much time learning how to operate it. These constraints led to a simplified system with continuous prompting called ELITE, containing the following subsystems which were focused on very specific tasks: 4a

Budget— assisted the user in filling out formatted budgetary forms and related justification statements. 4a1

Calendar— similar to the RADC Calendar subsystem but with the option of automatic notification via email. 4a2

Message — an interface to the ARPANET electronic mail package; similar to the Message subsystem available to all system users, but accessible from within ELITE. 4a3

Milestones— helped the user fill out a complicated project milestone chart in the specified Army format, update the time-lines and add, modify, delete and complete tasks. 4a4

Regulations— an index to a centrally maintained repository of Army and AMC regulations. 4a5

Suspense— a task assignment and due-date tracking subsystem, based on the RADC Correspondence system but more elaborate. 4a6

The ELITE system was programmed entirely by ALMSA people using the higher-level Command Meta Language for coding the user interface. This allowed developers to make calls to existing software in the "back-end" while providing a "front-end" that was deemed more user-friendly for its intended audience. 4b

AFCC, mid 80's 5

After early sponsorship by ALMSA, the Air Force Communications Command (AFCC) headquarters obtained their own contract to use AUGMENT services remotely at Tymshare. Subsequently, they leased 4 computers which were installed on-site at Scott AFB, Illinois, networked to each other and to the Defense Data Network. Initially the system was used to send/receive electronic mail among offices within the headquarters and between headquarters and field organizations. But the plan was to support the "staffing" activity throughout the entire 1500-person headquarters to the extent practicable. To accomplish this, additional features and capabilities were needed: 5a

Roles — Within AFCC (and most government offices) correspondence is directed to offices, not individuals. The correspondence must be answered, actions taken, decisions made, regardless of who may be filling the role of office-chief at the moment. A roster of people allowed to act on behalf of the office chief is maintained. A simi-

lar function was developed within the system, which allows roles to send/receive mail, establish reminders, make appointments, assign action-items, and sign documents — while maintaining the identity of the individual who was acting in the role at the moment. 5a1

Signatures — There is a legal necessity to be able to sign and verify signatures on correspondence. A means of accomplishing this was developed using a variation of the government-approved Data Encryption Standard (DES) public-private key encoding. In addition, at AFCC, it was decided that every document that was electronically signed should be considered an important organizational record, and therefore, was automatically entered into the Journal (considered by AFCC to be the corporate memory bank). 5a2

Disposition-codes — A complex 2-volume set of "rules and tables" specified the length of time documents of all types should be retained and the conditions under which they should be destroyed or archived. Periodically, office administrators would have to review all documentation stored in the office and determine its disposition. The introduction of the system caused administrative people to re-think these rules and procedures. As a result, it was determined that the document's author was the best judge of the retention value, that five codes would be sufficient to cover the range from Temporary to Permanent, and that only those documents entering into the Journal need be coded. This approach was cleared for experimentation with the National Archives. 5a3

Suspense — a greatly expanded version of the RADC and ELITE approach, it allows the assignment of action-items and due dates to roles/individuals. The task can subsequently be reassigned any number of times, commented, completed, and cancelled or closed. As a transaction is made, the appropriate people are automatically notified via email and Reminders are set or cancelled as required. The resulting distributed database can be searched and flexibly viewed and copied. Provisions are available for archiving classes of records automatically or under database administrator control. 5a4

There were many other organizations that used the system throughout the 70s and 80s, many of which are listed below. The user population was distributed from Germany to Australia, with one remote shared-screen demonstration conducted from Singapore. The most common application of the system was for rapid communication via electronic mail, but applications ranged from: phototypesetting a complex JOVIAL programming manual, to conducting remote shared-screen briefings, to Zero Based Budgeting, to managing project libraries. 6

Government 6a

Air Force 6a1
AFCC - Air Force Communications Command 6a1a
ESD - Electronic Systems Division 6a1b
GUNTER - Gunter Air Force Station 6a1c
RADC - Rome Air Development Center 6a1d
WRAFB - Warner-Robins Air Force Base 6a1e
Army 6a2
HQ-DA - Headquarters, Department of the Army 6a2a
AAA - Army Audit Agency 6a2b
AMC - Army Materiel Command (also DARCOM) 6a2c
ALMSA - Automated Logistics Management Support Agency 6a2c1
ARRCOM - Armament Readiness Command 6a2c2
AVSCOM - Aviation Systems Command 6a2c3
CECOM - Communications-Electronics Command 6a2c4
ERADCOM - Electronics Readiness Command 6a2c5
MERADCOM - Mobil Electronics Readiness Command 6a2c6
MICOM - Missile Command 6a2c7
PTFD - Personnel and Training 6a2c8
TACOM - Tank and Automotive Command 6a2c9
TECOM - Test and Evaluation Command 6a2c10
PM-MEP - Army, Program Manager 6a2c10a
PM-SMOKE - Army, Program Manager 6a2c10b
YPG - Yuma Proving Grounds 6a2c10c
WSMR - White Sands Missle Range 6a2c10d
TRADE - Training and Development Command 6a2c11
TROSCOM - Troop Support Command 6a2c12
ARO - Army Research Office 6a2d
DESCOM - Depot Systems Command 6a2e
ANAD - Anniston Army Depot 6a2e1
CCAD - Corpus Christi Army Depot 6a2e2
LEAD - Leterkenny Army Depot 6a2e3
NCAD - New Cumberland Army Depot 6a2e4
RRAD - Red River Army Depot 6a2e5
SAAD - Sacramento Army Depot 6a2e6
SEAD - Seneca Army Depot 6a2e7
SHAD - Sharpe Army Depot 6a2e8
SIAD - Sierra Army Depot 6a2e9
TEAD - Tooele Army Depot 6a2e10
TOAD - Tobyhanna Army Depot 6a2e11
LCAQ - Logistics Communications Agency 6a2f
LSSA - Logistics Support Agency 6a2g
TSCHOOL - Army Training 6a2h

BOOTSTRAP PLANNING DOCUMENT

Working Draft

Important Note: The following prototype business plan was developed and ratified by an industry stakeholder committee for launching a multi-corporate *Bootstrap Initiative*. With a few modifications, this plan can be readily adapted to other scenarios, including: (a) a single organization, where the Members would be stakeholders from various divisions, departments, and programs; or, (b) an existing consortium, association, or other mission-oriented community. In this document, the Bootstrap Institute staff would play a central role, providing vision, direction, and operational support for the distributed Project team. In other scenarios, the operational support might be provided by the Members, and the Project team might be co-located. Communities can be international, rather than limited to US and Canada, and the Project could well extend beyond a year, depending on the resources available.

This document includes plans for a research prototype open hyperdocument system (OHS-2), which would be only the first in a succession of evolving proto- types (i.e. OHS-3, OHS-4, etc.). Please also note that the term *Handbook Cycle* is synonymous with the alternate term *CODIAK* (COncurrent Development, Integration, and Application of Knowledge).

—Doug Engelbart 3/10/92

<AUGMENT,132806,>

March 10, 1992

Note: The numbering to the right of each paragraph on the following pages is for easy reference during discussion. It is assumed that such dialog will be ongoing, and that this document will be revised accordingly, even after the Project is officially launched and the Advisory Council convenes.

TABLE OF CONTENTS

PROPOSED PROJECT ON Collaborative Knowledge Development

EXECUTIVE OVERVIEW 1

The complexity and urgency facing today's organizations will increase exponentially as we move into the next century. Unless organizations quickly learn to grow increasingly faster and smarter, they will soon surpass their ability to cope. Decades of unprecedented investment in change should be anticipated, where subtle differences in investment strategy will put some organizations far ahead of others in capability and effectiveness. 1a

Project Concept: Early strategic focus on improving tools and methods for collaborative knowledge development in complex projects offers a special investment leverage toward continuous, compounded improvement. Heterogeneous project teams which can coordinate their work online using highly effective tools and methods would be faster and smarter at identifying needs and opportunities, designing and deploying solutions, and incorporating lessons learned -- regardless of geographical distance. Applied in both the product-related activities and the improvement efforts of the enterprise, these breakthroughs could dramatically reduce both the product cycle time and the improvement cycle time, while increasing first-time quality. 1b

These generic capabilities would also provide a powerful infrastructure to support other key improvement efforts, such as total quality, enterprise integration, concurrent engineering, CASE, groupware, decision analysis, issue management, online document delivery, integrated CAD/CAM/CALS architectures, and multi-corporate collaboration. 1c

Content: A one-year Project is proposed to explore how knowledge workers can work together more effectively in a distributed online environment -- across application domains, vendor platforms, organizational boundaries, time and space. The primary task is two-fold: (1) to develop an implementation plan to fund the procurement of an "open hyperdocument system" research prototype (OHS) to support wide-area collaboration; and, (2) to produce plans for a follow-on multi-year Initiative. Toward this goal, the team will study and refine the strategic framework driving this work, the methods for online collaboration, application scenarios for future member pilots, and strategies for deployment and migration of results. 1d

Approach: The Project Approach will emphasize relevance and accessibility of the results to maximize transferability to member organizations. Full-time member Interns will work with the Project staff from their home offices as a prototype distributed project team. Drawing from extensive prior work, the Project staff will establish an advanced pilot environment of existing mainframe OHS-1 software and methods to support the Project team's own collaborative knowledge development process. The Project team will advance the OHS-2 tool and method design work concurrently through intensive OHS-1 usage experience and application scenarios based on projected member usage, and through a synthesis of extensive intelligence surveys, input from industry experts, dialog, lessons learned, and the evolving strategic framework. 1e

Deliverables: 1f

Quarterly
- Status reports
- Briefings
- Live demos

Operational Deliverables
- Advanced pilot environment
  . prototype software
  . prototype methods
  . transfer methodologies
- Internship program
  . unique pilot experience
  . intensive training
  . interns produce results
  . interns transfer results

Knowledge Products
- Multi-year Initiative plan
- OHS-2 requirements/specs
- OHS-2 implementation plan
- Methods requirements/specs
- Deployment strategies
- Strategic framework for organizational improvement
- Framework for collaborative knowledge development
- Application scenarios
- Extensive intelligence base
- Recorded dialog
- Lessons learned
- Recommended standards

Launching: Stakeholders representing 10-12 companies have been working with the Project Director this past year to formulate the business plans for the Project/Initiative, with initial "seed" support from Motorola, McDonnell Douglas, Mitchell Kapor, Apple, Sun, and Steelcase. The Project will run for one year. The cost of the one-year membership depends on size in revenues: $100,000 if larger than $1 Billion, and $35,000 if smaller than $1 Billion. Members will also contribute an Executive Liaison person to serve on the Board of Advisors, and one or two full-time Interns, reporting to the Project from their home office (interns are optional for $35K-level members, although not placing an intern will reduce the benefits of participation). Membership is open to any organization based in the U.S. and Canada. 1g

Leadership: This Project is motivated by the extensive prior research and experience of Dr. Douglas C. Engelbart, visionary and pioneer of integrated information systems and organizational augmentation. Well-known contributions include the mouse, display editing, multiple windows, outline and idea processing, hypertext, hypermedia, and groupware, with early prototypes in full operation under the NLS/AUGMENT system as early as 1968. After 20 years directing his own lab at SRI, 6 years at Tymshare (information systems vendor), and 5 years at McDonnell Douglas (large end-user org with complex project work), Engelbart founded the Bootstrap Institute, where he is working closely with industry stakeholders to launch the Project and Initiative. He is invited to speak internationally on many related topics, often as keynote speaker, has received awards for outstanding lifetime achievement and ingenuity, and is an associate at Stanford's Center for Design Research where he conducts the 3-day management seminar *"Bootstrapping Organizations into the 21st Century"*. 1h

BACKGROUND 2

The complexity and urgency facing today's organizations will increase exponentially as we move into the next decade and beyond. Organizations of tomorrow will look dramatically different, operating with an effectiveness that is well beyond what we know today. One obvious challenge will be the complete integration of information systems across every facet of organizational life, as well as a complete rethinking of organizational structure, methods, and procedures. This Project is a means for bringing advanced, highly effective capabilities to organizations much sooner and more effectively than the current marketplace might provide. 2a

An important first step toward such "quantum leap" effectiveness would be to improve the coordination capability among knowledge workers. A comprehensive approach to improving this collaborative knowledge development capability will provide significant benefits, such as supporting and integrating the following types of improvement efforts which are recently attracting much attention: 2b

- enterprise integration 2b1
- total quality requirements for close coordination across departments, customers, and suppliers 2b2
- cross-enterprise collaboration via joint ventures and consortia 2b3
- distributed business teams 2b4
- groupware, or computer-supported cooperative work (CSCW) 2b5
- computer-aided software engineering (CASE) 2b6
- concurrent engineering 2b7
- online document delivery (e.g. the DoD CALS requirement) 2b8
- CAD/CAM/CAE/CALS integrated architectures 2b9

Many vendors and consultants are already forging ahead with point-solution products and services to address specific isolated applications. Sizable projects have also been launched to address distributed network interoperability. 2c

However, it is not enough to simply link everyone's terminals and workstations together. Considerably more groundwork must be laid before diverse knowledge workers can flexibly coordinate their work online through shared files and shared screens, across application domains, vendor platforms, organizational boundaries, time and space. 2d

For the marketplace to deliver effective solutions quickly, end-user organizations will have to become much more pro-active. End-user organizations will face unprecedented challenges and expense in learning how to evaluate, integrate, apply, and deploy these new capabilities. They will need first-hand real-use experience via intensive pilot operations in which to evolve and refine the associated work methods, procedures, conventions, skills, and roles. This valuable experience will be a critical factor in determining the usage requirements for future information systems products and services. 2e

Decades of unprecedented investment and change should be anticipated. Assuming that the rate of return on wiser investments would be compounded, subtle differences in strat-

egy will put some organizations far ahead of others in capability and effectiveness. Where will your organization stand? 2f

Early strategic focus on improving collaborative knowledge development offers a special strategic investment leverage. A well-coordinated enterprise would be faster and smarter at identifying needs and opportunities, designing and deploying solutions, and incorporating lessons learned. Applied in both the product-related activities and the improvement efforts of the enterprise, these breakthroughs could dramatically reduce both the *product cycle time* and the *improvement cycle time,* while increasing *first-time quality.* 2g

Considering the rapidly shifting challenges facing today's organizations, and the restricted resources for coping with those challenges, this strategic approach will be critical to an organization's survival and success, offering compounded leverage for *"bootstrapping organizations into the 21st century".* 2h

CONTENT 3

A one-year Project is proposed to explore how knowledge workers can tackle complex projects more effectively within a distributed, online environment -- across application domains, vendor platforms, organizational boundaries, time and space. 3a

This work is motivated by a larger "bootstrapping strategy" for organizational improvement, which offers strategic choices in developing and deploying emergent information technology. The "bootstrapping" refers to investments in capabilities which provide extra leverage for future improvement, with a special emphasis on a "co-evolution" approach for developing new tools and methods concurrently. Early investment in the co-evolution of tools and methods that improve collaborative knowledge work offers special compounded leverage toward building increasingly faster and smarter organizations. Employed within complex projects, and also within the organizational improvement process, these new capabilities can reduce both the *product cycle time* and the *improvement cycle time,* while increasing *first-time quality.* 3b

The primary objective of this Project will be to develop the requirements and specifications for a research prototype "open hyperdocument system" in support of distributed collaborative knowledge development, and to formulate plans for a follow-on multi-year Initiative. The major component activities listed below are vital to these primary endeavors. Drawing from significant research experience, practical applications in industry and government, and an early prototype "open hyperdocument system", we will explore and refine: 3c

1. A framework for collaborative knowledge development 3c1
2. An Open Hyperdocument System (OHS) 3c2
   - OHS-1 Pilot Exploration 3c3
   - OHS-2 Implementation Plan 3c4
   - Preliminary OHS-2 Requirements 3c5
   - Implications for Industry Standards 3c6
3. Methods for *online* collaborative knowledge development 3c7
4. Deployment strategies 3c8
5. Special application areas (e.g. total quality, concurrent engineering) 3c9
6. A strategic framework for organizational improvement 3c10

All of these pursuits are completely interdependent, and also heavily influenced by the special Project process (see section on <Approach>). The experience and understanding gained in each area will offer substantial and invaluable grist to the whole. Following is a detailed description of the Project Content. 3d

1. A framework for distributed knowledge development (Handbook Cycle): 3e

Undertaking to specify tools and methods aimed at improving group knowledge work requires in-depth understanding of what knowledge workers generally need to do within the organization, and what would be profitable to improve. The following basic model, developed by Project Director Dr.Douglas Engelbart, will be used as a basis for evolving the Project's guiding framework. 3e1

In the face of increasing complexity and urgency, organizations must quickly learn to: 3e2

- find better solutions to problems 3e2a
- solve problems more quickly 3e2b
- solve more complex problems 3e2c
- find solutions to problems that were previously not solvable 3e2d

To achieve these goals will require dramatic and continuous improvements in how organizations perform knowledge work within complex projects. This process can be analyzed in terms of three interdependent and highly dynamic functions of continuously updated, integrated project knowledge: 3e3

- *Intelligence Collection:* Gathering and analyzing external information or reference material relevant to the project, including market surveys, competition, emerging technologies and techniques, customer profiles, and industry trends -- extracted from reports, articles, books, interviews, conference proceedings, etc. 3e3a

- *Dialog:* including memoranda, meetings, discussions, arguments, resolutions, lessons learned, exceptions, emerging issues, needs and possibilities, design rationale, abandoned approaches, change requests, etc. ("dialog" includes synchronous and asynchronous, face-to-face and remote). 3e3b

- *Project-State "Handbooks":* The dynamic knowledge products representing the project state, including plans, proposals, budgets, timelines, milestones, contracts, status reports, design specs, production specs, test results, manuals, field service logs, etc. -- continuously updated through a synthesis of intelligence and dialog. 3e3c

For lack of a better term, Engelbart uses "Handbook" to refer to the project-state knowledge products at any given stage of development, and "Handbook Cycle" or "collaborative knowledge development" to refer to the continuous process of creating, capturing, analyzing, distilling, updating, exchanging, and re-using these knowledge elements throughout the life of the project. 3e4

It is important to note that almost every effort in the organization is heavily immersed in, or impacted by, an ongoing Handbook Cycle. And each project's knowledge process and knowledge products must somehow tie in to many other efforts within and even outside of the organization. This is especially true where close coordination is required, as in concurrent engineering, or total quality management. 3e5

In the complex project environment of a large matrix organization, knowledge workers from many functional domains will contribute to selected areas within many different projects' Handbook Cycles, with each project resulting in massive volumes of documentation. For example, it is estimated that the documentation required to create and maintain an airplane may well outweigh the product. This documentation is developed by thousands of diverse knowledge workers, thousands of suppliers, numerous contractors, countless exchanges, countless revisions, all needing to be carefully coordinated over the life of the project (10-30 years). 3e6

As important as this documentation is, what is generally not documented, such as all the decision trails and intelligence collections, is often just as crucial to the success of the project. 3e7

Even minor inadequacies in the Handbook Cycle process can be very costly in terms of: 3e8

- Slip-ups in version control, such as when the engineering team is somehow working from out-of-date specifications; 3e8a

- slip-ups in the project "memory", as when a design team fixes a design flaw without access to the original design intent, and unwittingly follows the exact same dead-end path that was aborted 2 years earlier for well-documented (and forgotten) reasons. 3e8b

Often even more costly to the corporation are lost opportunities from: 3e9

- not having access to important intelligence information 3e9a

- less than adequate collaboration on important design issues 3e9b

Even in a relatively small, short-term project, the Handbook Cycle process is increasingly crucial to the success of the organization. Products are increasingly complex, and at the same time there is tremendous pressure for reduced product cycle time, requiring that more and more work be done concurrently. This in turn requires unprecedented coordination across the project functions and organizational boundaries. 3e10

There should be a tremendous strategic advantage in boosting the Handbook Cycle capabilities in our organizations. Dramatic improvements in how they create and manage the enterprise knowledge must be engineered, to transform knowledge domain islands into highly coordinated, sharable, well developed, interoperable Handbook Cycles. Such improvements can be realized by dramatically improving both the information-system tools and accompanying human processes and methods through a special "co-evolution" process of advanced exploration. 3e11

2. An Open Hyperdocument System (OHS): 3f

The Project team will study and define usage requirements and specifications for an Open Hyperdocument System (OHS), and produce an implementation plan to fund the development of a research prototype for subsequent use in member pilots (OHS-2). 3f1

Many vendors and consultants are beginning to develop products and services to address specific isolated application areas within the Handbook Cycle, such as groupware, or CASE. But as more and more of an organization's Handbook Cycle work moves online, and more of the work is done concurrently using a hodge-podge of workstations, networks, application packages, and utilities, they will be faced with a whole new set of challenges for coordinating the enterprise knowledge. 3f2

A central focus of this Project is the design and intensive use of a prototypical "Open Hyperdocument System" (OHS) as a potential strategic solution to these challenges. The "Open" refers to an integrated "seamless" multi-vendor architecture, where distributed heterogeneous knowledge workers can share files and share screens regardless of each worker's particular hardware/software configuration. The "Hyperdocument" refers to mul-

timedia files which support many object types, including hypertext links, hypertext publishing, and hypertext mail, designed to enable flexible collaborative creation, manipulation, study, and re-use online. (See Preliminary OHS-2 Requirements below <3F10>.) 3f3

OHS-1 Pilot Exploration: An advanced research prototype OHS will be used to support the distributed Project team's own knowledge development process, and to create an exploratory pilot environment within which the associated work methods can be concurrently developed. The resulting environment and experience base would then serve as a model for subsequent member pilots. 3f4

The "AUGMENT" system was selected for initial use in the Project as the only suitable advanced integrated OHS prototype available to support wide-area collaborative knowledge development. AUGMENT (OHS-1) was developed at SRI and is now owned by McDonnell Douglas, who will make the source code fully available to the Project. OHS-1 has been proven over the last decade in significant operational pilot trials in government and aerospace. It is extremely useful for demonstrating the integrated capabilities required in an OHS, and for the real-use experience base needed for designing the next-generation prototype. (An earlier version of this system was recently recognized with the "Software System Award" by ACM, a long-established association of computer professionals.) However, OHS-1 cannot be easily extended or supported. The code is in a non-standard language, runs under an obsolete operating system and mainframe hardware, and does not support a modern graphic user interface. (See Appendix-B References <OHS-1> for a description of its features.) 3f5

Therefore, it is vital to the Project goals, both to extend its own "living prototype" environment and to plan for member pilots, to build or buy a modern OHS prototype (OHS-2) as quickly as possible to run on modern workstation platforms and support emerging graphical interface standards. 3f6

OHS-2 Implementation Plan: An implementation plan will be proposed mid-year to fund the procurement of an OHS-2 research prototype, with targeted implementation completed early in the follow-on Initiative to expedite launching member pilots. This plan would be based on the usage requirements and system specification developed by the Project team of staff and member interns. Procurement alternatives will be evaluated to determine the most cost-effective approach for building an OHS-2: 3f7

- in-house development 3f7a
- contract development 3f7b
- purchase and modify 3f7c

The Advisory Council of member representatives will work with the Project team to decide the best approach in light of technology, timing, and budgetary options at the time. A separate call for funds may be initiated at that time to cover the costs of implementation. 3f8

Given this plan, the coalition of Project members would then have a unified front, backed by real-use experience, to stimulate the commercial production of open hyperdocument systems and associated applications, utilities, and consulting services to support subsequent wide-scale deployment within member organizations. 3f9

Preliminary OHS-2 Requirements: A great deal of preliminary work has already been done by the Project Director and staff, and by McDonnell Douglas personnel, to define the functional requirements of an OHS-2 prototype (see Appendix-B <OHS-2>). This work is the re-

sult of long-term analysis of complex Handbook Cycle requirements, and from operational usage of OHS-1 in significant pilot trials. 3f10

These preliminary OHS requirements are recommended as a baseline starting point only. There is much more to be learned about the rigorous use of an OHS in a wide-area, distributed Handbook Cycle process. The human-system elements -- all the methods, procedures, conventions, skills, etc. -- must be highly developed, in close association with the further evolution of OHS requirements. To launch this co-evolution, intensive and purposeful exploratory pilot environments must be established. The first such will be with OHS-1 in the Project. 3f11

Project members will work together to refine (or redefine) the requirements and specifications for OHS-2, using the Project's OHS-1 pilot environment as a point of reference and experience base. Members will develop usage scenarios for prospective member pilots, collect and analyze an extensive survey of related activities, products, and services, with synthesis through intensive dialog among member participants (see section on <Approach> for more details). 3f12

Implications for Industry Standards: Technically speaking, an OHS in the commercial world will not be a software package, but rather a set of standards and protocols which software developers would follow so that a heterogeneous user population can create and exchange Handbook Cycle elements interoperably, regardless of preferences for applications, utilities, workstation platforms, and networks. 3f13

Understanding the requirements for these standards and protocols can only be accomplished through close cooperation among vendors and user organizations, and through extensive real-use experience. The "living prototype" workmode of the Project and subsequent pilot trials of the members will provide an extremely valuable fertile environment for discovering and evaluating these requirements. 3f14

Note that the Project will not itself be setting standards; it will rather publish well-documented recommendations to be presented by member companies to existing standards groups. 3f15

3. Methods for online collaborative knowledge development: 3g

The Project team will study and define methods for online collaborative knowledge development, resulting in usage requirements and guidelines for member application. 3g1

The Handbook Cycle processes used to collect and analyze intelligence, record dialog, and develop project-state "handbooks" will be very different in the online world from those used in the "paper world". Careful evaluation and development of methods, procedures, conventions, skills, and organizational roles for facilitating the online Handbook Cycle need to be accomplished before members attempt to take the technologies in-house. 3g2

For example, if users do not apply some formal process and discipline to the structure and format of their sharable documents and intelligence databases, or to the assignment of keywords, or file-naming conventions, how will anyone find what they need among the thousands of Handbook Cycle elements under continuous development? What are the protocols for making changes in a shared file? How do you keep track of thousands, or tens-of-thousands of important documents, with previous versions of each for the record, and

still have a handle on the project state? Who will be responsible for distilling the knowledge and organizing it online? What will the job description be, and how will you groom someone for that role? How would you run an OHS-supported meeting? Which existing practices and attitudes within your company would need adjustment to get the most out of these new capabilities, and how would this be tackled? How would you effectively harness "smart-agent processes" from the artificial intelligence realm? 3g3

These issues are all a critical part of the equation for dramatically improving the collaborative knowledge development process, and for effectively introducing and harnessing the technology within member pilots. And these methods must not be developed simply as a parallel effort to the tool development -- rather the new tools and methods must be developed hand-in-hand. Otherwise the tools will simply automate existing outdated practices, or the methods will be adapted to existing inadequate technologies. What is needed is a tightly knit co-evolution of tool/method prototypes within exploratory pilots. In addition, extensive ongoing surveys of existing methods, services, and practices will be conducted to avoid re-inventing the wheel. For example, what is already known about cataloging intelligence data? How are current groupware products affecting meeting-room dynamics? (See section on <Approach> for more details.) 3g4

This body of data would then be analyzed in terms of applicability within an advanced, fully-integrated online OHS environment, and also mapped against application scenarios of prospective member pilots. The Project team would also be experimenting with applicable methods in their own online Handbook Cycle work, with lessons learned feeding directly back into the tool requirements. 3g5

Different procedures or conventions will be appropriate to different work styles and environments. However, there is much commonality regardless of the particular situation, because the bulk of the exploratory work is in understanding all the related issues, where the methods and conventions might be needed most, what the available options are, and how well they have worked for others in similar situations. 3g6

4. Deployment strategies: 3h

The Project team will study and define the strategic deployment and migration of the Project results within member organizations, as well as applying the results to boost the results-transfer process. 3h1

Planning for strategic deployment of results from the Project (and later Initiative) within the Members' organizations is an integral part of the Project Approach. 3h2

Most organizations need to overhaul the way they identify, select, and transfer new technologies or methods into the organization. Often the tools or methods selected do not adequately address the requirements, they do not integrate well, or they are not introduced well. Improvement projects will only get more and more complex, the requirements for improvement will shift more and more rapidly, and the opportunities for improvement will increase exponentially. The way an organization assesses needs and opportunities, designs and deploys solutions, and incorporates lessons learned, will be increasingly critical to its survival and success. One of the goals of the multi-year Initiative is to dramatically improve the "improvement cycle time" as well as the "product cycle time" within member organizations, using the same tools and methods that support Handbook Cycles within complex projects. 3h3

The one-year Project is designed to give members a head start in the improvement transfer process by preparing the member participants, as well as the tools and methods, for the follow-on member pilots. The unique approach for designing and co-evolving the tools and methods, with intensive hands-on participation of end-user groups, will maximize the applicability and transferability of the results (see section on <Approach> for more details). Member interns will be tasked with developing application scenarios within prospective member pilots to lay the groundwork for the detailed pilot-project plans, as well as driving the design work. Member liaisons will be tasked with positioning their organizations to prepare for the pilot selection and planning. 3h4

In addition, the Project team will be operating within a "living prototype" of co-evolving tools and methods, continuously subjecting themselves to improvements on all fronts. Where possible, formal notes will be kept on the lessons learned which, combined with intelligence data on existing technology transfer methods, will form the basis for a new "handbook" on pilot projects (this will be extended considerably during the Initiative phase). 3h5

In the multi-year Bootstrap Initiative, a key activity will be the detailed planning and launching of member pilots. These pilots will serve as an important extension of the Project pilot exploration, as well as providing a mechanism for the transfer of Project results. Many pilots should be launched -- some for furthering the advanced exploration, some to give elite project teams the experimental advanced capabilities, and some to give the "regular" workers a "taste" of what is to come. 3h6

5. Special application areas: 3i

The Project team will study and define commonalities among, and implications within, special application areas. 3i1

If the tools and methods for improved distributed knowledge development, or Handbook Cycle work, are to be truly applicable within complex projects, the design must be driven by usage requirements. The interns will be tasked with developing detailed scenarios of prospective member pilots to address a wide range of group knowledge-work domains, such as enterprise integration, concurrent engineering, total quality management, CASE and software effectiveness, and CALS. Using the Project tools and methods, member interns will collect intelligence and consult with experts in the given application areas, exchange dialog, and map the applicability of the generic Project work within these special-purpose domains, to identify the commonalities among them. This is extremely important for pursuing effective Handbook Cycle interoperability across knowledge domains. The results will feed directly back into the requirements definition of OHS-2. 3i2

In addition, the results will be used to evaluate how the functional requirements of these application domains would be affected by an OHS-2. In other words, how much of what is currently programmed into a software package for CASE, or decision analysis, or meeting facilitation, is already supported by the OHS-2, or, given OHS-2, what special-purpose functionality would the packages then need to consist of? Embedding the basic generic functionality within the OHS will maximize the open interoperability factor, while minimizing the cost of creating, learning, and supporting the various specialized software applications. 3i3

And, finally, the results of this task will be used as a basis for planning member pilots. 3i4

6. A strategic framework for organizational improvement:

This Project and follow-on Initiative are motivated by a comprehensive strategic framework for continuous, accelerated, compounded organizational improvement. Refinement of this strategy will receive much more consideration in the follow-on Initiative. This work will focus on effective ways to identify, define, integrate, and transfer new process and tool improvements within a rapidly shifting operational environment. An important part of this work is the process of launching, managing, and evaluating exploratory pilots, as well the use of special High Performance Support Teams (professional teams specially trained and equipped to support operational activities with advanced capabilities). 3j1

A-B-C Model: As a starting point, the Project team will work with Dr. Engelbart's "A-B-C Model of Organizational Improvement", which depicts two functional levels of improvement activity within an organization: 3j2

A = The Product-Producing Activity (e.g. manufacturing airplanes, conducting medical research, management consulting, passing legislation) 3j2a

B = Improving A Activity (e.g. introducing CAD, email, upgrading quality processes, developing a new training program) 3j2b

C = Improving B Activity (e.g. learning more effective ways to research available options, to integrate and transfer solutions, to develop project knowledge) 3j2c

Most organizations do not have any recognized C Activity, and their B Activity is generally adhoc, often left to the individual worker or group to figure out. Even when well supported, the B Activities are usually fragmented -- i.e. the tools are developed to automate existing (obsolete) methods, and vice versa. These activities are typically chartered to introduce a one-time change. 3j3

If organizations are going to get faster and smarter, they have to get much much better at improving themselves. They need an explicit C Activity to turn their B Activities into a highly coordinated, highly skilled, highly effective, and coherent improvement process. 3j4

The Project and Initiative represent a formal C Activity, and were specifically designed to support, improve, and integrate the B Activities within the member organizations. The same tools and methods resulting from this Project and subsequent Initiative can also be readily applied to C and B work, as well as much of the A work, for: 3j5

- recognizing opportunities 3j5a
- identifying requirements 3j5b
- designing and deploying solutions 3j5c
- incorporating lessons learned 3j5d

This is where the "bootstrapping leverage" comes in. The "bootstrapping" refers to a process of continuously boosting an effort using the results of its own work. In this case, the iterative results of the Project will be used to keep boosting the Project's effectiveness, as well as boosting the work of the respective member B Activities, and their respective A "clients". The pursuits of the Project were specifically selected for this strategic compounding effect. 3j

During the Project, interns will be trained in this A-B-C bootstrapping model, and oriented to think of their work as C Work, supporting and improving the B Activities in their home organizations. Their work developing application scenarios will involve heavy collaboration with member B Activities which are already planning and implementing programs in total quality, concurrent engineering, or CASE. The extensive intelligence collections and intensive dialog from the Project on related activities, tools, methods, improvement transfer techniques, products, and services, will be extremely valuable to the existing B Activities, as will be the lessons learned from the Project. At the conclusion of the Project, the interns will be expected to take positions back in the member B Activity to begin transferring the tool/method prototypes within pilot operations in the B, and later the A Activities. 3j7

Given this A-B-C improvement model as a starting point, the multi-year Initiative will further evolve and refine a strategic framework for organizational improvement. 3j8

Co-Evolution and Augmentation: Another key element of the strategic framework has to do with targets for improvements, or augmentation. Each target capability is deeply embedded in the fabric of human/tool culture within an organization. In recent centuries, this fabric has remained largely intact, with the ripple effect from spurts of innovation making quiet adjustments over several decades. Now, with the explosion of the information age and its accompanying computer revolution, the speed of technological innovation is increasing exponentially, leaving the human side of the equation -- the methods, procedures, conventions, etc. -- seriously obsolete. 3j9

Now there is less and less time for the intricate fabric of the organization to adjust and evolve naturally. It is now necessary to engineer changes on the human side, in close association with the tool side, to avoid becoming seriously out of synch with one another. This "co-evolution" approach to human-tool augmentation will become increasingly important as the rate and scale of change continue to increase. 3j10

Considering the rapidly increasing complexity and urgency facing today's organizations, and the restricted resources for coping, reducing the *improvement cycle time* will be just as critical to an organization's survival and success as reducing the *product* cycle time. This dual-result approach offers compounded leverage for *"bootstrapping organizations into the 21st century"*. 3j11

APPROACH 4

It is impossible to predict exactly what will be required by the organization of the future. The best we can do is adopt a pragmatic strategy for creating faster and smarter organizations, by improving the exploration process that will eventually enable them to steer and maneuver with greater and greater efficiency. The Project Approach is to do just that. By launching and accelerating the continual co-evolution of tools and work methods for collaborative knowledge development, the Project will establish a highly collaborative, steadily improving, advanced exploration process, including: 4a

1. Intensive pilot usage for balanced co-evolution 4a1
2. Intensive member participation 4a2
3. Detailed scenarios of future member pilots 4a3
4. Lessons learned 4a4
5. Ongoing extensive surveys 4a5
6. Ongoing recorded dialog and exchange 4a6
7. Explicit strategy for results transfer 4a7
8. Comprehensive framework for strategic investment 4a8

This approach is designed to maximize relevance and transferability, while serving as a unique new model for collaborative research and improvement transfer. Following is a detailed description of this approach. 4b

1. Intensive pilot usage for balanced co-evolution: 4c

The "living prototype" environment will provide first-hand experience for member designers and implementers, and an industry focus for standards requirements related to special application domains. Beginning with OHS-1 and a starting state set of methods provided by the Project staff, team members will actively use and evolve the online Handbook Cycle methodologies in close coordination with the OHS-2 design work, and weave the lessons learned back into the design process. The resulting successive prototypes will support the Project Approach, as well as the Project Content work. (This process of employing the successive results of the Project within its own knowledge development process is a key element in the bootstrapping strategy described in Item 6 under Content <3J>.) 4c1

2. Intensive member participation: 4d

Members will participate extensively through an "Executive Liaison" person, and one or more "Interns" working full-time on the Project team in the "living prototype" environment. Interns and Executive Liaisons will represent the member usage requirements and interests through an intensive collaborative process, and channel the results of the Project back into their home organizations. (See section on Member Participation for more details <5>). 4d1

3. Detailed scenarios of future member pilots: 4e

An early and ongoing assignment for the Interns will be to work closely with related member improvement activities to develop detailed roadmap scenarios and usage requirements

for candidate in-house pilot applications. These scenarios, representing a wide variety of complex projects (e.g. CASE, total quality), will evolve throughout the Project as the interns gain increasing expertise in the "living prototype" environment, and as they collaboratively explore and study the many surrounding issues. (See also Item 5 under Content <3l>). 4e1

4. Lessons learned: 4f

The Project will be the first advanced-outpost pilot -- a "living prototype" environment where the tools and methods are co-evolved, and the results employed by the interns to conduct their group knowledge work. Wherever possible, the lessons learned will be recorded, and fed directly back into the design work in a very tight feedback loop. 4f1

Later, in the multi-year Initiative, members will be launching exploratory pilots, employing OHS-2 and associated work methods, and will be actively feeding a constant stream of lessons learned, needs, and possibilities (not proprietary data) back into the Initiative's continuing requirements definition. 4f2

5. Ongoing extensive surveys: 4g

Project team members will survey existing works on an ongoing basis by collecting, cataloging, analyzing, and ingesting intelligence information on important related activities, tools and methods. Topics will include groupware, hypertext, team processes, project methodologies, models for organizational improvement, meeting facilitation, CASE, CALS, performance metrics, integration of video, etc. The media collected will range from brochures and conference proceedings, to taped (and possibly transcribed) interviews with industry experts, and recorded demonstrations of emerging technologies. An extensive hyperdocument intelligence library will be developed and maintained for use by the Project team, and by B Activities (improvement programs) in the member organizations. 4g1

6. Ongoing recorded dialog: 4h

The Project team will be engaged in intense, ongoing dialog about the many elements of their work, including: the intelligence collection, the scenarios under development, the pilot environment, how the emerging tools and methods can best be deployed within the Project and member pilots, the lessons learned, the successive drafts of project plans and design specifications, procurement approaches, the Handbook Cycle framework, implications for special application domains, implications for standards, etc. Dialog will also be conducted with selected industry experts. A synthesis of this dialog will be fed back into the Project's knowledge products. Because participants will be working online, often from remote sites, this dialog will be largely captured online, and therefore recorded for subsequent analysis and re-use. 4h1

The Project team will also periodically meet face-to-face. This dialog will be recorded on audio (possibly video) tape. Minutes will be entered online for the record. As funds permit, the team will also study and explore how meetings are impacted when participants have been working in an intensive online OHS environment, and how to support and facilitate meetings using the OHS-based tools. Lessons learned will feed back into the design process. 4h2

7. Explicit strategy for results transfer 4i

As a strategic issue, the Project Approach deals specifically with the transfer of results at several levels. The "living prototype" environment, member participation, scenario development, lessons learned, and intensive dialog will act as a catalyst for creating deliverables which are maximally relevant and transferable to the member pilots. In addition, the prototypical tools and methods resulting from the Project, designed to boost the Handbook Cycles within complex projects, will be highly applicable later on for boosting the complex project of transferring improvements into member organizations (see also Item 4 under Content <3H>). 4i1

The Project will hopefully become a model for the effective transfer of results from other consortia. This can also extend to transfer from vendor products and services, and in-house improvement projects, into member pilots. 4i2

8. Comprehensive framework for strategic investment 4j

This Project dovetails into, and is driven by, a comprehensive strategic framework for investing in organizational improvement, particularly in developing and deploying emergent information technology and methods (see Item 6 under Content <3J>). 4j1

This strategic approach should result in better and better ways to perform each of the tasks described under <Content> and <Approach>, and eventually serve as a generic dynamic model for conducting any complex collaborative project work. 4k

MEMBER PARTICIPATION 5

Each Full Member organization is expected to provide one or two full-time interns to staff the various activities of the Project projects. Much of their project participation will be conducted remotely from their home office using the prototype OHS system to collaborate. This participation is vital to the function of the Project, to the collaborative definition of user requirements, and to the infusion of results into the member organization. Interns will serve for the full Project year, whereupon they will be rotated back into their member organizations, hopefully to support internal member pilots where their expertise can be most effectively propagated. Organizations electing to join the follow-on multi-year Bootstrap Initiative will then place interns on a one or two year rotation basis. 5a

A key element of the Project is intensive collaboration among a wide range of stakeholders. The "Executive Liaisons" from participating Member organizations will collaborate on planning and direction, and the "Interns" will collaborate at the hands-on level. 5b

Executive Liaison 5c

Each Project member will assign a liaison entrusted by the corporate executives to represent the Member's interests in the Advisory Council, and to position the Member organization for effective transfer of the Project results. As a minimum, the Executive Liaison will attend all quarterly briefings and progress meetings, and coordinate the Intern's access to Member resources, including establishing ties to related B Activities (improvement programs) within the company. The Executive Liaison might expect to spend up to one-quarter time on matters relating to the Project. 5c1

Internship Program 5d

The internship program is a program of total immersion for the Member Interns in the "living prototype" Project pilot, including extensive training and coaching, and intensive team work with other members. Interns will be expected to perform much of the Project work, and to produce a significant portion of the Project deliverables, including intelligence collection and analysis, scenario development, debating the issues, contributing to the design work, and documenting the results. 5d1

This Program has strategic importance in that members will be fully represented in the requirements definition, the results will be highly relevant, the Interns will gain the expertise to effectively transfer the results in-house, and the members will get a head start in positioning for the future based on first-hand knowledge and experience. 5d2

The Intern selection process is very important. They must be innovative dedicated team players, with a genuine pioneering spirit, and a strong background in process, design, and/or project management. Interns would ideally be able to effectively represent their company's improvement needs and plans in a detailed manner, through prior experience and by establishing and maintaining close contact with related in-house activities (with help from the Executive Liaison). A technical background is NOT required. Candidates must be approved by the Project Director. 5d3

Some managers have voiced a reluctance to "give up" such an employee for a full year. In debating this issue, it is important to consider: 5d4

- Who do you want representing your companies' broad interests? 5d4a
- How else would you propose to transfer the multi-faceted results in-house? 5d4b
- What if all the other members selected the same caliber person you selected? 5d4c
- What kind of staffing would it take to launch this type of advanced research in-house, who would you put in charge of that, and why? 5d4d

Interns will report to the Internship Program Manager, and will work closely with the Project Director and his staff. Most Interns will work from offices at their home organizations -- traveling to the Project site (Palo Alto, CA) initially for intensive training, total immersion in the online environment, and team building -- and returning periodically for follow-on coaching and face-to-face team work. Back home, they will work full-time as a distributed Project team. Members may alternatively place their Interns onsite with the Project staff for more extensive exposure. At the end of the Project year, the interns will return to work for the Member company, to begin the full-time task of transferring the results in-house. 5d5

Intern Alternatives 5e

The success of the Project will depend on a core team of Interns from Member organizations dedicated full-time to the Project research and deliverables. As such, each Full Member should contribute at least one full-time intern. In addition to this minimum, or as an alternative where exceptions are granted, the following can be considered as valuable contributions (subject to approval by the Project Director). These include donating graduate students, or faculty, or sending extra money in lieu of an intern. 5e1

Graduate Students: Members may consider contributing additional staff by "routing" them through a graduate study program at Stanford University (or other nearby university), beginning in June. Graduate student Interns would be expected to work a minimum of half-time in the Project. Master-level students can be accommodated quite directly. PhD-level involvement would require negotiating with each students' research professors and is not at all straightforward. Note that these students must first be admitted into Stanford on their own merit. Note also that because of their fluctuating academic schedules and priorities, their labor cannot necessarily be counted on in any critical path for deliverables. 5e2

An alternative would be to select and recruit an already-enrolled graduate student to work in the Project on behalf of the Member. This type of graduate student Intern would not necessarily be as effective at representing the Member's requirements, and may not have enough of a "presence" back home to effectively transfer the results in-house. 5e3

Visiting Faculty: Members may wish sponsor a faculty member from a local university to spend a sabbatical year working in the Project. This Faculty Intern may not be able to effectively represent the Member's requirements, or transfer the results in-house after the Project. However when they return to their home university they would be qualified to spawn a cluster of active Bootstrap participants at that university, through a similar study program for Member-sponsored staff. 5e4

Another form of Faculty Intern would be for the Member to sponsor a qualified employee to teach for a year at Stanford part-time (or other nearby university), and work part-time in the Project. 5e5

Extra Fees: In the exceptional case where a Full Member cannot free up the staff to donate full-time, the Member may consider paying an extra $100,000 to cover the cost of hiring an Intern onto the Project team. 5e6

Supporting Services 5f

Interns will be provided an integrated pilot environment in which to learn, apply, and evolve the bootstrapping concepts, including: 5f1

OHS Support Service: Access to and use of OHS-1 to include mainframe computer service, basic training, coaching, and hotline support. 5f1a

Vision and Direction: Support from Dr. Engelbart and his staff (and consultants as funds permit), including long-range vision and planning, intensive ongoing seminars, workshops, and team-building, task assignments and evaluation, project management, guidance in advanced exploration. The staff will also coordinate with the Executive Liaisons, interface with other research groups, consultants, industry associations, and standards groups, and generally promote the underlying strategic framework through articles, papers, books, video productions, lectures, and management seminars (e.g. the 3-day Bootstrap Seminar). 5f1b

It is expected that as more organizations join, the Project would fund an expanded level of support to include, for example: 5f2

- procurement of OHS-2 5f2a
- expanding the range of technical and staff support 5f2b
- specialty consulting, for example bringing in an expert on cataloging keyword conventions 5f2c
- enhancing the facilities (offices, meeting rooms, specially-equipped training rooms, library) 5f2d
- assistance in planning for pilots within member organizations 5f2e
- expanding the project scope (e.g. how and when to apply metrics in the pilot evaluation process) 5f2f

DELIVERABLES 6

The goal of this Project is to provide members with information, experience, working prototypes, and a strategic framework to ascertain and address their own companies' requirements. The Project will employ a unique strategic approach, emphasizing relevance and accessibility of the results to maximize transferability to the member organization pilots. The results developed by the Interns will be proprietary to the members for one full year after the Project. 6a

Summary of Deliverables 6b

<u>Reports & Briefings</u>	<u>Knowledge Products</u>	6b1
• Status reports	• Multi-year Initiative plan	6b2
• Briefings	• OHS-2 requirements/specs	6b3
• Live demos	• OHS-2 implementation plan	6b4
	• Methods requirements/specs	6b5
<u>Operational Deliverables</u>	• Strategies for results xfer	6b6
• Advanced pilot environment	• Strategic framework for	6b7
. prototype software	organizational improvement	6b8
. prototype methods	• Framework for collaborative	6b9
. transfer methodologies	knowledge work	6b10
• Internship program	• Application scenarios	6b11
. unique pilot experience	• Extensive intelligence base	6b12
. intensive training	• Recorded dialog	6b13
. interns produce results	• Lessons learned	6b14
. interns transfer results	• Recommended standards	6b15

The plans for the Initiative and for the OHS-2 implementation will be proposed in the third quarter of the Project year. All knowledge products will be developed and delivered as online cross-indexed hyperdocuments. Certain key reports will also be printed. Following is a detailed description of the Project deliverables. 6c

Reports and Briefings 6d

Quarterly: Quarterly deliverables will include status reports documenting technical progress and financial status, onsite briefings, and live demos. A meeting of the Advisory Council of Executive Liaisons will be held (at the Project site in Palo Alto, CA, or other mutually agreeable site) to review accomplishments, problems, potential solutions, direction of the Project, and plans for the follow-on Initiative. 6d1

Workshops/Seminars: It may be desirable to conduct 1- to 3-day seminars during the course of the Project for the general education of member (and non-member) management apart from those directly involved in the Project. These will be arranged on an as-needed basis. 6d2

Mid-Year: A mid-year report will be presented to the Advisory Council detailing options for procurement or in-house development of a rapid-prototype OHS-2. The Advisory Council will work with the Project team to decide on the best approach, considering the resources

available. The Advisory Council may choose to issue a separate call for funds to boost the development effort. 6d3

Final Report: A final report will be produced at the close of the Project and disseminated to members. It will document the technical progress made toward the objectives of the Project, problems encountered with solutions proposed or tried, summary of lessons learned, and recommendations for further work. 6d4

Documented Case Project: If sufficient funding is available, an independent third-party research team will be contracted to evaluate the Project, including sociological, technical, and economic potentials and results. 6d5

Operational Deliverables 6e

Advanced Pilot Environment 6e1

The Project and Initiative will support an advanced "living prototype" pilot environment in which to assess, develop, test, evaluate, apply, integrate, and deploy evolving tools and methods. This will be a demonstration environment, and a model for future member pilots. 6e1a

Prototype OHS-1 Software: This existing prototype mainframe software will be maintained for use by the Project team (staff and interns) to conduct the Project work. OHS-1 is not recommended for wide-scale deployment and should be replaced according to the OHS-2 implementation plan as soon as funds permit. 6e1b

Prototype OHS-2 Software: If and when the prototype OHS-2 becomes available, it will replace OHS-1 as the Project's exploratory pilot system, and subsequently will be directly transferable to member pilots. 6e1c

OHS-2 code for any software developed during the course of the Project will be delivered at the end of the study via a medium jointly agreed upon by the Project members. 6e1d

Prototype Handbook Cycle Methods: All associated methods, procedures, skills, processes, conventions, and organizational roles developed to accompany the OHS will be available for deployment in member pilots. 6e1e

Transfer Methodologies: The methods developed for improved results transfer will be available for use by members in launching in-house pilots. 6e1f

Internship Program 6e2

Interns Produce Results: Member interns will be expected to make major contributions in the work of both the Project and the Initiative. The quality of the deliverables will be directly proportional to the commitment of member interns. 6e2a

Unique Pilot Experience: Interns will be given extensive exposure to the knowledge, experience, and insights of the Director and his staff, as well as direct intensive hands-on experience in the highly augmented, distributed, collaborative group knowledge development process. 6e2b

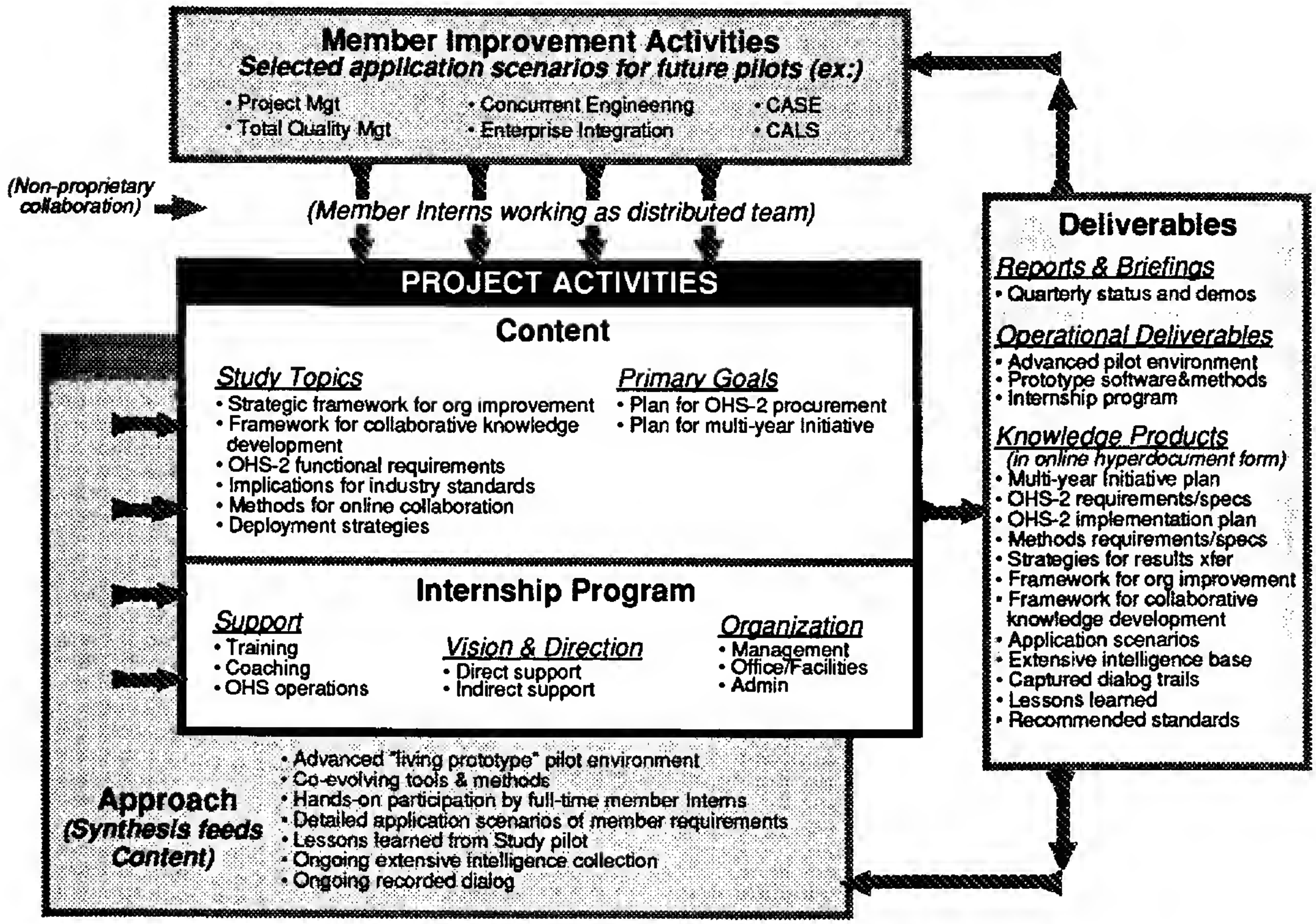
Intensive Training: Interns will be given extensive training in the use of OHS and associated methods. Up to a month of training at the Project site will be followed by remote support using the telephone and the OHS Mail and Conference systems, with regular trips back to the Project site for follow-up coaching and onsite teamwork. 6e2c

Interns Transfer Results: At the end of the Project, with guidance and planning from the Project team, and assistance from the Executive Liaison, interns will be expected to move back into the B Activity (improvement projects) of member organizations, with responsibility for transferring the results of the Project back into their home organization. 6e2d

Knowledge Products 6f

During the course of the Project, the following knowledge products will be developed within the Project team's Handbook Cycle process using the prototype OHS-1. This evolving knowledge will be developed in online hyperdocument files, continuously updated, indexed, cataloged, annotated, and cross-referenced, through a synthesis of the Project Approach elements. Resulting intelligence collections and recorded dialog will be cataloged and retrievable online as supporting documentation for each of the following deliverables. Individual documents, or hyper-linked indices to them, may be printed remotely or down-loaded at any time by the member interns. Selected versions of key documents will be printed for distribution to the members. 6f1

- Multi-year Bootstrap Initiative plan 6f1a
- OHS-2 requirements and specifications 6f1b
- OHS-2 implementation plan 6f1c
- Methods requirements and specifications 6f1d
- Deployment strategies 6f1e
- Strategic framework for organizational improvement 6f1f
- Framework for collaborative knowledge work 6f1g
- Application scenarios for future member pilots 6f1h
- Extensive intelligence base 6f1i
- Recorded dialog 6f1j
- Lessons learned from Project pilot 6f1k
- Recommended standards for commercial OHS products and services 6f1l


Member Improvement Activities
Selected application scenarios for future pilots (ex:)
• Project Mgt
• Total Quality Mgt
• Concurrent Engineering
• Enterprise Integration
• CASE
• CALS
(Non-proprietary collaboration)
(Member Interns working as distributed team)
PROJECT ACTIVITIES
Content
Study Topics
• Strategic framework for org improvement
• Framework for collaborative knowledge development
• OHS-2 functional requirements
• Implications for industry standards
• Methods for online collaboration
• Deployment strategies
Primary Goals
• Plan for OHS-2 procurement
• Plan for multi-year Initiative
Internship Program
Support
• Training
• Coaching
• OHS operations
Vision & Direction
• Direct support
• Indirect support
Organization
• Management
• Office/Facilities
• Admin
Approach
(Synthesis feeds Content)
• Advanced "living prototype" pilot environment
• Co-evolving tools & methods
• Hands-on participation by full-time member Interns
• Detailed application scenarios of member requirements
• Lessons learned from Study pilot
• Ongoing extensive intelligence collection
• Ongoing recorded dialog
Deliverables
Reports & Briefings
• Quarterly status and demos
Operational Deliverables
• Advanced pilot environment
• Prototype software&methods
• Internship program
Knowledge Products
(in online hyperdocument form)
• Multi-year Initiative plan
• OHS-2 requirements/specs
• OHS-2 implementation plan
• Methods requirements/specs
• Strategies for results xfer
• Framework for org improvement
• Framework for collaborative knowledge development
• Application scenarios
• Extensive intelligence base
• Captured dialog trails
• Lessons learned
• Recommended standards

BENEFITS 8

Offsetting Costs 8a

In discussing benefits, one must seriously consider how much change to expect in the coming decades -- 10%? or a factor of 10? Assuming dramatic, sweeping, increasingly rapid and complex change, one must then consider: 8a1

- what kind of organization will have the strength and agility to maneuver and thrive in that environment? 8a1a
- how will your organization be transformed into that kind of organization? 8a1b
- how much experimentation can your organization tolerate? 8a1c
- how much will the exploration cost? 8a1d
- what is it costing you each year NOT to have these capabilities already in place? 8a1e
- how do you propose to find an appropriate strategy for achieving this transformation? 8a1f

Preparing for the future will most likely entail unprecedented expense, effort, and adjustment. Finding an appropriate strategy will be crucial. 8a2

Practical Strategy: This Project offers members a cost-effective opportunity to explore and refine a comprehensive corporate strategy to get better and better at improving itself. 8a3

Immediate Pilot Experience: This Project offers immediate hands-on experience in an advanced "living prototype" environment. Creating a comparable exploratory pilot in-house would require considerably more resources and time to establish, and would be lacking the rich collaboration potential from other participants. 8a4

Cost-Effective: The Project offers a cost-effective and highly productive means for organizations to assess and subsequently assimilate advanced group knowledge work capabilities. 8a5

Valuable Intelligence: Transforming your organization will also require constant surveillance of important external activities, products, and services. The Project's extensive and coherent intelligence collections should be a valuable supplement to existing in-house improvement efforts. 8a6

ROI: Organizations that invest heavily in projects requiring large scale integration of evolving knowledge will benefit the most from Project membership. In addition to employing future knowledge-work capabilities effectively, members can better harness in-place technologies by learning to adapt the advanced online methods from the Project. 8a7

Organizational Memory: Capturing design intent should cause significant reductions in redundancies, both in repeated errors, and in re-deriving design decisions. Learning from others' lessons and best practices should lead to first-time quality. 8a8

Quality Knowledge Work: The quality of enterprise knowledge should increase significantly through improved coordination, and through the awareness that each knowledge

element contributed to the pool could actually be highly useful and greatly relied upon downstream. 8a9

Leveraged Investment 8b

The unique Project Approach is designed to maximize the investment leverage, while reducing and sharing the risks of exploration and experimentation. By pooling resources, members can spend less to get more, thus freeing up more internal resources for in-house investment. 8b1

Compounded Investment: The Project Content and Approach are aimed at reducing both the product cycle time and improvement cycle time, while boosting first-time quality. The continuous improvement process launched within the Project can be subsequently transferred to member pilots. 8b2

Advances on Many Fronts: The Project results are designed to support and integrate many related improvement efforts, such as enterprise integration, groupware, CASE, CALS, project management, and total quality. Researching their commonalities will lead to a "big-picture" view for coordinating and accelerating these efforts, while minimizing redundancy and costly information islands. 8b3

Leveraging Other Resources: This Project is expected to attract resources that would otherwise not be readily available to the individual organization, such as top-notch industry experts, whole intelligence collections donated by other related research activities, and the potential for grant money to supplement the follow-on Initiative. 8b4

Leveraging Other Results: Members who are involved in other consortia, initiatives, or multi-corporate R&D alliances will be better equipped to transfer and integrate those results. 8b5

Competitive Positioning 8c

More and more an organization's competitive advantage will depend on its ability to leverage its intellectual resources. In an increasingly "white-collar" world, enhancing the productivity of individuals, teams, and organizations will require much more emphasis on the use of computer and communication tools to support collaborative work. And the process of technology/process infusion will be far more complex than ever before. With so much at stake, subtle differences in strategy could put some organizations far ahead of others in capability and effectiveness. 8c1

Faster and Smarter: The comprehensive corporate strategy for continuous breakthroughs in capability, leading to better and better ways to coordinate knowledge work and deploy solutions, should result in faster and smarter organizations. Members will have a chance to jump "ahead of the pack" in acquiring these capabilities. 8c2

Long Range Vision: This Project provides a long-term vendor-independent vision for organizational improvement in which to evaluate current and future requirements for information-systems products and services. 8c3

Managing Diversity: The Project Content and Approach are designed to offer significant potential for managing diversity in a rapidly shifting global economy. 8c4

Experience and Positioning: Early hands-on experience in the advanced "living prototype" environment offers members a significant potential advantage, including an early start at positioning their companies for strategic in-house implementation of the Project results. 8c5

The Concurrent Enterprise: Boosting the coordination and integration of knowledge work across organizational boundaries and functional domains would enable the organization to operate as a "collective mind" with enhanced strategic thinking and decision making. The large scale integration of knowledge should also influence first-time quality through improved concurrent coordination of all the enterprise participants, including customers, suppliers, and joint-venture partners. 8c6

Continuous Organizational Improvement 8d

The Project will launch a comprehensive strategic process for continual and accelerated improvement in knowledge development and organizational performance. 8d1

Reducing Improvement Cycle Time: Project interns will learn to employ the Project results to manage and accelerate change -- i.e. to make better use of increased quantities of intelligence data, to better identify needs and opportunities, to collaborate quickly and effectively on the design and deployment of solutions, and readily incorporate lessons learned. 8d2

Coordinated Efforts: Integrating an enterprise -- including individuals, teams, information systems, methods, and procedures -- requires a "whole system" or "big picture" view. The Project's co-evolution approach, together with the strategic bootstrapping, offers a valuable framework for coordinating improvement efforts throughout the enterprise. 8d3

New Vendor-User Paradigm 8e

In preparing for a future of unprecedented challenges, the stakes may well be too high for each organization to forge ahead alone. Joining forces is feasible when the work is generic and future-oriented, not proprietary, and in many cases highly desirable because rigorous exploration will be very costly. In addition, joining forces will be necessary for solving many basic global problems that lie ahead. The development of an appropriate open hyperdocument system is a clear example. Understanding the requirements for highly collaborative interoperability among many.diverse knowledge domains, coordinating the standards and protocols for interfacing or integrating applications software and utilities -- can only be accomplished through extensive cooperation among vendors and user organizations, where extensive shared applications experience is critical. 8e1

Industry Focus: The Project will provide an industry focus for the collaborative involvement of user organizations, vendors, consultants, government agencies, and universities -- a melting pot and proving ground for testing and integrating new tools and methods relating to collaborative knowledge development. 8e2

Future "Knowledge Workshop": Members will get a real "taste" of what the future working environment could be to help guide strategic planning efforts. The intensive real-

use experience with OHS tools and methods will help end-user organizations to understand and articulate their requirements. 8e3

American Competitiveness: This "back-door" collaboration will be vital to future American competitiveness. Japan and Europe have already begun mobilizing in this general direction. The Project will also provide a ready-made platform for winners of the Malcom Baldridge Award to fulfill their obligation to share learning experiences. The eventual infusion of resulting capabilities into American industry, as well as social and government institutions, could make a huge difference to competitiveness. 8e4

Forging New Connections: Participation in the Project will expand member connections to other relevant activities and industry experts, as well as forging new and valuable associations within and across industries. 8e5

Extra Leverage for Vendors/Consultants 8f

Information systems vendors and consultants whose business requires incisive perception of the future should benefit in extra ways from participation in the Project. The unique Project Approach may offer a new model for supplier/customer relations. This is especially desirable for companies learning to practice total quality management or concurrent engineering, which require a high level of collaboration and coordination across functional areas, including customers, suppliers, and joint-venture partners. 8f1

Stimulated Marketplace: The Project will motivate and guide major customers to take a more pro-active role and plan for the widespread assimilation of information technology; participating vendors will have the opportunity to work closely with them in shaping their plans and direction. This involvement will help alleviate vendors' guesswork about customers' future needs and how they plan to assimilate products into their rapidly shifting, increasingly complex environments. 8f2

New Product Lines: Vendors and consultants who learn to employ the Project's strategies internally can leverage their resulting expertise to provide a valuable new or improved line of business in consulting services -- assisting users in assimilating the complex new work modes. Members will also have a jump over their competitors in incorporating the Project results into existing R&D efforts. 8f3

Visibility 8g

Participation in this Project will make a strong statement to your customers, suppliers, competitors, and to your own employees, that you are serious about working with other industry leaders to forge a long-term strategy for pursuing future organizational improvement. 8g1

Timing 8h

American competitiveness will depend on decisive action from American industry and government. 8h1

Some people have asked "why don't we join after the results are completed?". Here are some serious considerations: 8h2

- nothing will be completed without industry leadership 8h2a
- creating knowledge-work interoperability will require close cooperation by all major stakeholders early on 8h2b
- the direction and focus of the work, and hence the results, will be shaped by the early participants 8h2c
- he most valuable results of the Project will not be the reports, but rather the rich experience from intensive collaboration within a co-evolving advanced pilot environment 8h2d
- with or without the Project, forging into the future will only get more and more complex and expensive; the longer this work is postponed, the more heavily invested your organization will be in its current direction 8h2e

Comparing Other Activities 8i

***Unique Project Approach*:** 8i1

- concurrent "co-evolution" of tools and methods 8i1a
- usage-driven requirements (through framework study, member application scenarios, and intensive pilot use of successive advanced prototypes), as opposed to product driven (creating long-term vision based on existing technologies) 8i1b
- head start with tools and methods explicitly developed for this purpose, with more than 20 years of operational usage experience in industry 8i1c
- explicit provisions for transferring results into member organizations by expert interns equipped with the Project tools/methods, with relevance maximized by the Project Approach 8i1d
- dovetails into a comprehensive strategy for continuous organizational improvement. 8i1e

Model for Other Consortia: The Project Approach can be applied as a new model for running many complex distributed projects, including constortia. 8i2

ORGANIZATION 9

This Project is being formed as a one-year project on Collaborative Knowledge Development. The Project is modeled after MCC's Technology Project, which is a mechanism to allow the members to begin pursuing their common objectives while the detailed plans for a full-scale Program are still being formulated. 9a

The Bootstrap Institute, directed by Dr. Douglas Engelbart in Palo Alto, CA, will be contracted by the Project, to provide vision, experience, direction, and operational support for the Project, including the Internship Program. An Advisory Council of Executive Liaisons will meet quarterly to review the Project's progress and to provide input on its future direction. 9b

By the end of the Project year, the multi-year Bootstrap Initiative will be formed as a non-profit consortium. All rights to the Project results will be transferred to the subsequent Initiative. 9c

Management: The Bootstrap Institute staff is broadly experienced in the design and implementation of integrated hyperdocument groupware systems, work methods, and pilot deployment, from both an engineering and an anthropological perspective. The Project Director, Dr. Douglas Engelbart, is a recognized leader and visionary in the field, having pioneered strategic frameworks for organizational improvement, groupware, hypermedia, outline and idea processing, multiple windows, display editing, and the mouse, with integrated prototypes in full operation under the NLS/AUGMENT System as early as 1968. Engelbart directed his own research lab at SRI for 20 years, and moved on to become senior scientist at Tymshare, and later at McDonnell Douglas Corporation (MDC), where he worked closely with the Aerospace Components on issues of integrated information-system architectures and associated evolutionary strategies. In addition to directing the Bootstrap Institute, Dr. Engelbart is an associate at the Stanford University Center for Design Research, where he conducts a 3-day management seminar. Engelbart is invited to speak internationally on many related topics, and has received several awards for outstanding lifetime achievement and ingenuity. 9d

The Project's Associate Director, Christina Engelbart, has 4 years experience as AUGMENT account manager in Washington, D.C., 5 years as a partner in a Silicon Valley start-up venture, and 4 years working closely with Dr. Engelbart as general manager of the Bootstrap Institute. Raylene Pak, the Software Manager, worked for 5 years at MDC as manager of the AUGMENT Software Development Group, with over 5 years prior experience managing and developing software for NASA's Pioneer spacecraft. Duane Stone, the Project's Internship Program Manager, has 10 years experience overseeing R&D projects for the Air Force, and 12 years with Tymshare and MDC, where he was responsible for AUGMENT marketing, customer support, product specification, and launching pilot trials in government and aerospace. 9e

The expertise of this unique Bootstrap team will be complemented by industry consultants, as funds permit, and the contributions of member Interns. 9f

See <Appendix-A> for more detail on the Bootstrap Institute Management Team. 9g

COSTS 10

The targeted cost of the one-year Bootstrap Project will be $1,000,000, with a minimum of $600,000 to launch. 10a

The $600,000 minimum is sufficient to produce the OHS-2 implementation plan, the plan for the follow-on Initiative, and to make some progress toward the other knowledge-product results. Costs include base level operating expenses, minimum facilities, salaries for the Project Director and his staff of 4, an Internship Program for 6-8 interns, and operation of the OHS-1 mainframe computer, which interfaces to remote public net-work and Internet email. 10b

Additional funds above $600,000 would allow greater progress through an increased staff, consultation from industry experts, the ability to support more interns, and better facilities. Additional funds could also provide for expanded scope, including procurement or development of a rapid-prototype OHS-2 suitable for supporting member pilots. In the third quarter of the Project, a report will be produced detailing the implementation options and associated costs for an OHS-2 prototype. At that time, existing members may elect to raise any additional funds required to speed the development effort. Some sample candidate areas for Project enhancement are listed in Item <5F> under Supporting Services. The Project Advisory Council will determine the optimum allocation of resources available. 10c

The term of the Project is one year. Project members have no obligation beyond the Project completion date. However, it is assumed that if the Project is productive, most members would expect to continue and expand the advanced exploratory research by forming the follow-on multi-year Bootstrap Initiative. The Advisory Council will work closely with the Project Director, his staff, and interns, to consider the alternatives, and to prepare a detailed plan to raise the necessary funds. This plan should be completed in the third quarter of the Project, to allow time to recruit additional members, and to create the necessary organizational structure. 10d

The Project membership fees are structured according to size in revenues of the participating organization. Membership in the one-year Project os open to organizations based in the U.S. and Canada. 10e

Full Membership 10f

The cost of Full Membership is the Membership Fee (below), plus assignment of an Executive Liaison person, and one or two full-time interns. In return, these members will receive rights to use any software developed, all knowledge products, intensive training and direction for the intern, and first-hand experience in the "living prototype" environment. Full members are also entitled to vote in the Advisory Council. 10f1

Revenues	Membership Fee
> $1 Billion	$100,000
< $1 Billion	35,000

10f1b

Associate Membership 10g

The Associate Membership was created to allow participation of smaller companies who cannot afford to place an intern in the Project, and is only available to members with revenues less than $1 Billion. The cost of an Associate Membership is $35,000, plus assignment of an Executive Liaison person, with no intern. The Executive Liaison will represent the Member in the Advisory Council, including participation in all discussions, but will not vote. By not placing an intern, the Associate Member will not learn as much from the Project -- i.e. will not participate at the detail design level, will miss the valuable first-hand experience in the "living prototype" pilot of the Project, and will not develop the expertise necessary to transfer the results to in-house pilots. However, for some organizations, this is the only means for participating in the collaboration, and gaining access to the reports and briefings. 10g1

Membership Manpower Commitment 10h

Intern-Associated Costs: All interns will be supported with a home office, including a modem phone line, desktop computer, assorted commercial software, and peripherals. Interns outside the San Francisco Bay Area should expect to make 6-8 trips during the Project year, with a duration of 1-3 weeks per trip, for team-building, training, coaching, and face-to-face teamwork. Additional remote costs include network usage charges for accessing the OHS-1 mainframe (remote access est. $10-20K/year for full-time use). These costs, combined with the cost of salary and benefits for the intern, are not insignificant. However, the return on manpower investment should also be significant. Consider the alternative cost of staffing a comparable exploratory pilot in-house, without benefit of the Internship Program, the Project staff knowledge and experience base, or the fully tested and documented prototype OHS-1 software. (See <5D> under Member Participation for more details on this Program.) 10h1

One alternative to allocating existing staff would be to support one or two graduate students to work as interns. The salary, overhead, and travel expenses would be considerably reduced, and there would be no network usage charges. However, these interns would not get the same total immersion as the full-time intern, may not have enough background to fully represent the Member company's interests, or the established connections to successfully spearhead the in-house pilots at the completion of the Project. 10h2

A Full Member who does not provide an acceptable Intern within two months of joining will be required to contribute an additional $100,000 to cover the Project's cost to hire a replacement. 10h3

Executive Liaison: In addition to the interns, each Member organization is to provide a designated Executive Liaison person to act as a management interface between the Project and the upper management of the Member's organization. This activity will ensure that a clear understanding of both the member's needs and the Project's methods and advances are appropriately conveyed. The Executive Liaison should expect to spend up to one quarter

time on matters related to the Project, and to visit the Project site at least 5 times, with a minimum of 3-5 days per visit. 10h4

Exceptions 10i

The Project framers recognize that there will be some organizations who wish to join and have much to contribute but cannot afford the full fee, or cannot afford to place an intern, or have goods and services to offer in lieu of a fee. Any such exceptions can be presented to the Advisory Council for special consideration on a case by case basis. 10i1

APPENDIX-A BOOTSTRAP INSTITUTE MANAGEMENT 11

Director: Dr. Douglas C. Engelbart 11a

The Director and chief architect of the Bootstrap Institute has a thirty-year track record as a pioneer of integrated information systems and organizational augmentation. PC Magazine best summed up Engelbart's accomplishments in presenting him in 1987 with the Lifetime Achievement Award for Technical Excellence: 11a1

> *"Doug Engelbart's contribution to personal computing is almost inestimable. As the father of the mouse and one of the most insightful people on the human-to-computer interface, Engelbart has spent a lifetime advancing the state of the art. [...] Doug Engelbart, as pioneer and visionary, helped make it happen."* 11a1a

In 1957 Engelbart was employed by Stanford Research Institute, where he launched his own research lab and built up its staff to 47 members. This lab, later known as the Augmentation Research Center (ARC), was one of the earliest efforts to build interactive knowledge-work tools. 11a2

Over the next 20 years Engelbart developed a strategic framework for organizational improvement -- his "bootstrapping strategy" -- which became the driving force behind his well-known pioneering work with the mouse, display editing, hypermedia, shared-screen teleconferencing, online hypertext publishing, integrated email, outline and idea processing, multiple viewing modes, multiple windows, cross-file editing, formatting directives, and online help. Most of these now-common features were conceived in the 1960s, and were in daily use at ARC by 1970 under the name "NLS" (oNLine System). Engelbart and two of his researchers from this period received in 1991 the ACM Software System Award for this early work. 11a3

ARC also originated a universal "user interface" front-end module, including what was perhaps the first instances of protocols for virtual terminals and remote procedure calls, as well as a grammar-driven command language interpreter. Engelbart's lab was also the second node to be connected to the ARPANET, and was responsible for initiating its Network Information Center (NIC). His work has resulted in over two dozen patents. 11a4

In the past two years there has been a surge of interest and exploration in the new, inter-related topics of "Computer-Supported Cooperative Work" (CSCW), "Groupware," and "Hypertext". It is now recognized that Engelbart's emphasis at SRI on supporting collaborative work, and the breadth of associated system development, not only clearly anticipated this major trend, but produced in the NLS system what is still the most comprehensive system for supporting wide-area collaboration. 11a5

In 1978, Tymshare bought SRI's commercial rights to NLS, renamed it AUGMENT, and set it up as the principle line of business in a newly-formed Office Automation Division. Since 1984, when McDonnell Douglas Corporation acquired Tymshare, Engelbart has been working closely with the Aerospace Components of MDC on issues of integrated information-system architectures and associated evolutionary strategies (a direct extrapolation of the work begun at SRI). 11a6

In 1989 Engelbart founded the Bootstrap Institute, where he is working closely with industry stakeholders to launch a Bootstrap Initiative to put his strategies into wide-scale practice. He is also an associate at Stanford's Center for Design Research, where he conducts his 3-day management seminar *"Bootstrapping organizations into the 21st century."* 11a7

Dr. Engelbart has served on NSF oversight committees, is invited to speak internationally on many related topics, often as keynote speaker, has published dozens of articles, has been featured in many articles, books, and documentaries by other well-known authors, and has received several awards for outstanding lifetime achievement. In March 1991, Dr. Engelbart was inducted into the American Ingenuity Hall of Fame, sponsored by Coors, which *"recognizes individuals whose accomplishments are due largely to innovation and perseverance...to honor individuals who have forever changed the way we do business in the United States."* 11a8

Associate Director: Christina Engelbart 11b

Christina helped build and direct a computer company, designing and developing computer systems for convenience stores. She produced the business plans, helped secure three rounds of funding, research and develop system prototypes, sign up the nation's second largest convenience chain as a customer, hire and manage 24 employees to complete the product, and oversee the installation of 65 systems in the field. 11b1

Christina's background is in cultural anthropology, with a special focus on organizational behavior. She had three years experience supporting Tymshare's AUGMENT customers in the field, and one year involved in the design of the AUGMENT integrated mail system. 11b2

Software Manager: Raylene Pak 11c

Raylene managed the Augment software development group at McDonnell Douglas for the past five years; for the past two years she has had sole responsibility for all aspects of Augment software including overall design, new capability development, maintenance and interfaces to a variety of networks and mail systems. During the mid eighties, she implemented and/or designed Augment features such as: Reminders, Electronic Signatures, Sequential File Structuring and Journal/Mail Searching. 11c1

Raylene's background is in computer science. Prior to her work with Augment, she spent over five years managing and developing software for NASA's Pioneer spacecraft. While there she was responsible for a variety of projects ranging from micro-coded communications software to 4GL-based data base systems. She has experience with a wide range of programming languages and processors. 11c2

Intern Program Manager: Duane Stone 11d

Duane has been involved with the Augment system since the late sixties, establishing the first pilot installation in the Air Force in the mid seventies. He then moved to Tymshare in 1978 where he was involved in Augment marketing, customer support, and product specification. Later at McDonnell Douglas he managed a series of pilots which used Augment in support of: the Artificial Intelligence Community, Teaming and Collaboration Project, National Aerospace Plane Program, CAD/CAM/CALS Program, and the Advanced Tactical Fighter Program. 11d1

Duane's background is in electrical engineering, with early work for the Air Force in R&D for the intelligence community and later for the command and control community. Technical areas covered include textual data processing, information storage and retrieval, database management, distributed processing, and wide-area networks. 11d2

APPENDIX-B
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INTELLECTUAL IMPLICATIONS OF MULTI-ACCESS COMPUTER NETWORKS

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ORGANISMS AND ORGANIZATIONS 2

I'll take an unlikely start and begin with dinosaurs. I have a six-year-old son who is tremendously impressed and intrigued with dinosaurs. We read and re-read all of the dinosaur books, and every time we go to the library we have to bring home new ones. 2a

Consider a dinosaur (with what little we know and much we may speculate) as a big, monstrous organism whose specialized organs cooperated reasonably well by the then-prevailing standards of "organism design", but whose function was coordinated by a clumsy, crude nervous system and a pitiful little brain. My image of this "clumsy nervous system" can be characterized by the story I've heard (or perhaps this is one that I've invented for six-year-old consumption, and now believe) about an embattled dinosaur not sensing for several minutes that it was dead. 2b

But yet apparently this was an organism marvelously fitted to its environment. The dinosaurs thrived for over 200 million years, as I remember from all those books, much longer than our race has been around. But suddenly -- suddenly in terms of geological time -- they disappeared. 2c

My learned deduction, derived from first-grade scientific literature, is that competition from better-designed nervous system did them in: better sensors; better sensory-data analyzers (perception); better peripheral contingency decision making (reflexes); better coordination of the functioning of organs, muscles, etc; better rational analyses of events and history; better accumulation of learned experience; better projection, visualization and planning, etc., etc. 2d

I want to fix in your minds an image of a biological organism that possessed formidable capability within the environment into which it evolved, but which couldn't make the grade against the competition that a continuing evolution brought into that environment. 2e

Human organizations can be linkened to biological organisms, and I find much value in considering the analogy. Organizations evolve too; their mutations are continually emerging and being tested for survival value within their environment. I happen to feel that evolution of their environment is beginning to threaten today's organizations, large and small -- finding them seriously deficient in their "nervous system" design - and that the degree of coordination, perception, rational adaptation, etc. which will

appear in the next generation of human organizations will drive our present organizational forms, with their "clumsy nervous systems", into extinction. 2f

It is these "nervous-system" functions, within human organizations, where I find the most significant intellectual complications stemming from the forthcoming multi-access computer networks. 2g

AUGMENTATION SYSTEMS 3

For many years I have been developing a research program at Stanford Research Institute aimed at Augmenting the Human Intellect. By intellect I mean the human competence to make, send, exchange and apply to decision-making the commodity called knowledge, as applied toward giving human individuals and organizations more effectiveness at formulating and pursuing their goals. My basic formulation of such a pursuit considers a large system of things to be involved in being intellectual, and being successful at it. A rough but useful categorization of the system's components is as follows: 3a

Biologically Provided Human (BPH) capabilities are the basic components of this "large system" -- e.g., memory, visualization, learning and reasoning, as linked to the human's internal-external environment by sensory-perception and coordinate-motor I/O/ systems. 3a1

Culturally Provided (CP) items are also basic to this "large system": general things such as languages, methodologies, tools, and training; in specific forms such as algebra, schools, meetings, books, computers, maps and filing cabinets. Also, such items as the value structure, attitudes, motivations, etc. which are so important to the way an individual coordinates and directs his BPH capabilities, may similarly be said to be "culturally provided". 3a2

An Effective Individual (EI) has a particular system of these CP items built atop his BPH capabilities. Our EI is like a little colony grown around the "raw-material" human, where in number and diversity of items this "ecology" of interdependent dynamics is as subtle and rich as what we are coming generally to appreciate in the "organic" world around us. 3a3

An Effective Organization (EO) is composed of a group of EI components, plus another particular set of CP items associated with their working together. 3a4

These CP items are all candidates for redesign, toward more effective individuals and organizations. To provide a new "augmentation system" for an individual, or especially for a group, is a very complex challenge. Just suppose, for instance, that a really new system had been developed, and consider the problem of checking out a group of people on their "new augmentation system -- it would involve such as: teaching them new concepts and skills for representing and manipulating information; changing their working and collaborative methods; having them learn new roles and acquire associated new attitudes; changing the format and style for their formulating and communicating, etc. 3b

If the system is to represent a truly significant improvement, assume that the changes to which the new users must accommodate will pervade many levels and

facets of the "way of doing their daily work", and that many of these changes will represent radical departures from their prior "ways". The people being given such a new system will have a rough period of learning and adaptation. People don't generally appreciate how many are the "little ways of doing things" that comprise our workaday world, that they may be subtly or radically changed, and that among them might appear a very different distribution of usage and importance. The EI and EO systems are more complex, but therefore richer, domains for development than is appreciated even (especially?) among the technologists in the computer and communication disciplines which have so much potential for changing those systems. 3c

My main message about Augmentation Systems is that, while indeed there are very challenging technical problems involved in supporting tomorrow's Effective Individuals and Organizations, the larger Augmentation System is much more complex than the technological "subsystem" upon which it depends. We technologists aren't equipped to perceive this sort of thing, and those who are can't generally distinguish the Sunday-Supplement extrapolations from those more probable. It has been my business to struggle with these concepts for two decades now, and the signs that I read at least tell me that the changes in our ways of thinking and working will be more pervasive and extreme than ANY OF US appreciates -- a revolution like the development of writing and the printing press lumped together. The following notions represent some of the least fuzzy elements that I perceive. 3d

THE INTELLECTUAL WORKSHOP 4

In the context of this Conference, it is useful to talk about providing an individual with a "private intellectual work space" -- sort of what his office is supposed to be for him now. 4a

In using his office, an individual goes in, perhaps shuts his door, and spreads his current working information over his working surfaces. He keeps some local files there, does some thinking, some formulating and transmitting of messages to the outside, and receiving returning messages, etc. Some of these transmitted formulations are requisitions for things to be bought, made, commented upon, or etc. He sends them out and results will come back, usually in the form of information -- control feedback, substantive information from colleagues or support staff, etc. He digests, stores, reformulates, responds, and occasionally pursues reflective, creative thought. 4b

The image I'm trying to develop is of an office being the "intellectual workshop in which one does his collaborative bit within his working environment: one needs work spaces, tools to suit a myriad of tasks, places to store working materials, aids to hold them for examination and shaping -- and they all should be easy to reach, quick to adjust to the task, easy to keep track of, etc. Interactive computer aids will have very significant effects here. 4c

This is the particular area that my group and I have been working on for some six years -- improving the individual's intellectual workshop -- as the first stage of exploring what augmentation might be like. By today's standards, we can

demonstrate some impressive features in the workshop environment which we have created to test by our daily use (for doing our daily work). But by our own perspective, as developed through constant struggle in this domain, we have but a primitive outpost on an unbelievably rich frontier. References 1 through 4 describe our work. I invite you to become acquainted, e.g. with Reference 1. Copies of the movie (Reference 20 are available; viewing this provides the best introduction to our "augmented office". 4d

It will take the explorers of this domain decades to even map its currently visible dimensions. The real rush hasn't begun: this Conference is a meeting of suppliers looking at the prospector trade; we haven't really been giving attention to the developments that will follow the prospecting. 4e

My research group is now moving into a next stage of work that we call "team augmentation". Here, instead of just the individual facilitating his private domain of searching, studying, thinking and formulating, as his office place provides for him, we are exploring what can be done for a team of "augmented individuals" who have in common a number of terminals, as set of computer tools, working files, etc. (as we do) to facilitate their team collaborations. 4f

Our major initial step toward augmenting a team is to facilitate the collaborative dialogue between its members, aiming for new kinds and degrees of collaboration that can thus be achieved. 4g

COLLABORATIVE DIALOGUE 5

To discuss our "Dialogue Support System", consider a shared-file space. This is a common enough thing in today's time-shared environment; but our dialogue-file space comprises "frozen" contributions from the collaborators -- i.e., it represents the "Journal" of transactional entries that make up the collaborative dialogue, entries that are part of the history of things and aren't to be changed. 5a

Assume that you are a participant in this dialogue, as from a CRT terminal in your office. You have just contributed some sort of entry into this Journal -- some tentative formulation of a plan or design. You expect some of your collaborators to be interested. You may have installed an "attention" signal at entry time, aimed at a particular set of people. At their consoles, they either receive an "annunciator" signal to alert them, or may have come across you entry via any number of natural pathways in the course of their work. 5b

These other people can very quickly and flexibly survey your contribution. At any subsequent time, in any passage of your contribution, one of them can attach a "comment" to any specific entity (e.g., word, string of words, paragraph, drawing line or label in the drawing). A comment can be one word (e.g., "Congratulations!"), or a reference to a contradictory passage, or a long exhortation about a better way to do the whole thing, other people will be attaching comments at other places, including comments upon other people's comments. What soon evolves from such activity is a network of contributions that represents a full-scale discourse, distributed over time and, if you wish, over space. 5c

A good "office-support system" will provide powerful aids to improve the effectiveness with which one can participate in such a dialogue. For example, one needs speed and

flexibility in studying the consequent network of dialogue contributions and in filtering out that which is relevant -- for instance to make a successive version of a plan or design. We are evolving aids for searching through specified sub-nets and selecting upon such attributes as content, previously assigned descriptive tags, authorship, absolute or relative "publishing" time, and citation linkages; assembling passages from the dialogue, and from one's own notes, with flexible disposition of one's screen into "windows" for independently viewing different materials; easily affixing new links and tags to arbitrary segments of a given memo; conveniently copying into one's own working file a categorized compilation of extracts. etc. 5d

One recognizes, of course, that the existing system of professional journals represents a similar mode of dialogue, distributed as it were over space and time. But the computer-aided dialogue has certain advantages to offer: interchanges in cycle times of minutes or seconds instead of years or months; accommodating more items, and items of much smaller size, without overloading the "clerical system"; accommodating more people making simultaneous accesses and contributions; providing citation followup to exact items (i.e., the computer can take you almost instantly to look at the particular item cited within another "document"). 5e

Within a team that has the kinds of tools and methods that are easily foreseeable, these features are really quite interesting and exciting to consider. We are planning to experiment with this type of collaboration in support of our own system-development activity, within our own shop. 5f

OFFICE-SHARING AND DIALOGUE IN THE ARPA NETWORK 6

Our Augmentation Research Center, at SRI, is a participating site in ARPA'S experimental computer network (see References 5 and 6). My group is hoping that here the "augmented office" approach can be applied to a fuller advantage -- i,e., we hope to see researchers at other sites beginning to use the Office for their work, work other than "studying and improving the Office" (which is what my group does). Using our Office system from his home-site CRT terminal, a researcher in computer languages for instance could do the composing, modifying and studying associated with developing his research tools, with setting up and running tests, with integrating the results into his notes, and with communicating and publishing the results. 6a

His experimental programs and compilations may be run on the computer at his home site, or at other Network sites -- there will be means within the Office making it easy to interface to any special tools and data through the Network. The office is the place where special attention is given to facilitating such supportive intellectual processes as formulating specifications for service requested and for how to present the results and where in the office's records to insert them; there are general needs in this regard over many activities, and the access to all of the special tools being developed in other computer-research areas will be very much heightened if they can be used from an "office" where a unified approach was taken to harnessing these tools. Examples: send you analytic formulation to MIT'S Math Lab for processing; Utah's graphic-manipulation processes could construct your illustrations; and the ILLIAC IV can do your heavy computations. 6b

In this network, my group is slated to serve as the Network Information Center, which role offers new ways to experiment with collaborative dialogue. AS we ourselves learn how to deal with it within our "conjoint office space", we expect to begin offering use of our "Dialogue Support System", through the Network, to people scattered over the country who want to do collaborative things in pursuit of Network activities. For instance, two graduate students from different universities could work closely together on a project, or a professor at one site could serve as a thesis advisor for a graduate student at
another site. 6c

THE KNOWLEDGE MARKET 7

Here is a brief extrapolation into the future and its Augmented Individuals and Organizations, looking beyond both the ARPA Network and my little experiments with an Augmented Office and a Dialogue Support System. Obviously there will be steadily widening distribution of common-resource accessibility, and a steadily increasing number of people who spend a significant amount of their professional time at terminals. The greater amount and diversity of mutually accessible resources -- human, financial, technological -- will accelerate growth along a number of dimensions. In particular, there will emerge a new "marketplace", representing fantastic wealth in commodities of knowledge, service, information, processing, storage, etc. In the number and rage of transactions, and in the speed and flexibility with which they are negotiated, this new market will have a vitality and dynamism as much greater than today's as today's is greater than the village market. 7a

It seems apparent to me that, following this increased mutual accessibility between knowledge resources and consumers, will be the development of more "depth" in the range of both. E.g., just as with the roles of specialty shops and services in some of our industries today, there will be a large number of individuals and small groups each providing highly specialized services. Since their clientele will be drawn from such a large market, they will find a good business even where they serve only a small portion of the market and provide only seldom-needed special services. 7b

Let's look at a specific "for instance". Suppose that one person becomes extremely proficient in making small programs to generate a display or printout to show (particularly well) the status of a multi-task project. He is an independent agent in this multi-access computer network, working at a CRT console in his office at home. Perhaps he specializes in construction projects, and within this perhaps in steelwork erection. You are a management consultant working (from your home) on a short job helping to set up the production-control system for a construction project. When you realized that you might benefit from this kind of help, this is the sequence that takes place: 7c

Your man is easy enough to find because of computer help in searching for an evaluating special products and services. Suppose that you need something he can do for you with about 45 minutes's effort. You expect immediate accessibility for negotiation -- for instance: it takes you one minute to locate several candidates, two minutes to examine their relative credentials, 20 seconds interrogation of public records to select him as being available right now for your kind of problem, two minutes of personal dialogue to determine for both of you that his capabilities and your needs match, and 15 seconds to negotiate and legalize a contract. He does his job

in 40 minutes, and spends five more minutes transferring the results to you (with dialogue). 7d

He switches back immediately to a task sequence whose contract arrangement had permitted him such interruptions. In working on this job, you have been "time-shared" with several other jobs having higher priority, and several that were running "background". During the forty minutes he was off doing his thing for you, your higher-priority task sequences took you off on other pursuits. In fact, when he was done, you weren't ready to get back to him for twenty-three minutes, but the mutual-scheduling algorithm agreed upon in your contract took care of connecting you and him, when you were both ready, for your final dialogue. 7e

Your dialogue, of course, comprised both voice and shared computer graphics. Your mutually viewed display could be flipped back and forth between views of what he called forth on his end to show you, and what you provided to show him. As you were showing him your work domain, he was "catching" reference links into the specific items that he might later need to get at, entering quick notes on some of them. 7f

The whole dialogue was recorded, as a matter of course and for either of you to use later. The stored speech was digitized, and automatically segmented into the alternate passages of your exchange. During your dialogue, whenever one of you referred to a displayed item in your speech, your practice was to make an explicit screen-select action in association with the spoken reference term (e.g., with a "that line" or "both of these figures" expression), so that when any given passage might later be selected for "playback", the computer could re-create for you the image you were seeing and indicate the displayed entity being referenced. 7g

Some of the dialogue had stimulating and instructive contents for you, You wanted to save these and integrate them into your personal notes. Citations to this dialogue are easy to install in your notes, including citations to a speech passage -- where, upon later seeing such a citation and "calling for" the item it refers to, the associated bit string would be found and the speech passage played back for you. 7h

Perhaps you consider some of the speech passages to be useful enough to have them transcribed into text. A quick designation of your desire causes these speech strings to be transmitted to a service you customarily use for doing you transcription. This service harnesses the latest speech-recognition computer aids, implemented with special-purpose hardware and software, and includes skilled clerical staff who supplement the 98% capability of the machine. Your two-minute transcription job is scheduled through their served units quite automatically, and the text strings are routed back and inserted in their appropriate places without your further attention. You have established the convention with the service agency that un-decipherable or dubious passages will be tagged, and if you had wanted to you could have designated when you sent the job off that you wanted to be interrupted to resolve such when the material returned. 7i

When you and your contractor parted ways, you each might exercise an optional procedure which helps you record your impressions of the other. An important part of your value within this marketplace rests upon your ability to integrate effectively the skills and knowledge of others. So you pay careful attention both to your "intelligence" base which helps you keep track of appropriate people, and to conducting your negotiations and working relationships with an eye for doing well by the other guy --

because he too probably keeps an effective intelligence system and it might well be important to you later that he (or his friends) feels good about working with you. You also need to assess his potential value to you for other and different collaboration. 7j

It is recognized rather widely that computer networks raise significant problems about the privacy of closed information. The other side of the coin is that computer networks raise rather remarkable opportunities to benefit from the sharing of open information. I am quite convinced that there is very high value to be derived within the Computer-Network Knowledge Market from a degree of openness with what have heretofore been considered as private types of information. 7k

Among the members of a working team, this could mean keeping open as a matter of course all of their scratch notes, trial designs, etc. to their colleagues, and expecting them to browse, comment, etc. Once this is the standard operating mode, those aspects of a person's vulnerability that depend mainly upon another's lack of understanding and compassion begin to find a compensating safeguard in the fact that hurtful actions taken therefrom by another person tend also to have complete visibility. This visibility, plus long-lasting availability of notes and records, would be important to the processes by which each person evaluates his potential colleagues -- which soon becomes important to those concerned with personal growth within this market, and moves toward a lower significance otherwise hurtful actions attempted by those without mature concern for their own growth, or without ability to grow into or stay in a position where their comments and actions are trusted or seriously considered. 7l

This may seem unduly naive, I know. But then consider an Afghanistanian villager, whose entire worldly experience is with a primitive every-man-for-himself market: what might it sound like to him to hear a peer suggest that the marketplace would benefit hugely by operating upon the basis of trusting the other man's word. "I say that I will pay you next week for a dozen buns, and I walk away without counting how many buns you put into the bag." Unreal fantasy -- talk of credit accounts, checking accounts, credit ratings, credit cards, etc. What does this have to do with getting the best price for my goat, to deal with abstractions such as accounts, promises to honor, reputation, etc. in a formalized, recorded fashion? Ludicrous restrictions and dangerous vulnerability for a system to expect both me and my neighbor (adversary) to reveal our positions, stand behind the things we say and the marks we make, and depend upon the other to do so. 7m

It seems clear that today's Western-world economy couldn't be as strong as it is if such open vulnerability didn't prevail. I only wish that I knew the evolutionary dynamics that produced the attitudes and customs necessary to make the "honest openness" work -- obviously its practice in the Afghanistanian village would lead to disaster, and yet it likely was from just such a market environment that ours evolved. 7n

It seems not unreasonable to assume that survival value in our cultural evolution will favor institutions which support the most efficient Knowledge Markets (organisms which support the most efficient nervous systems). Then certainly the Knowledge Market will someday operate with more open trust in its knowledge interchange, to release for constructive ends a great deal of otherwise entrapped human energy. Those who grow up within such an environment will look back with pity upon the primitive fears and protective practices prevailing in 1970. 7o

SUMMARY 8

I think that tomorrow's institutions can be (must be) far better adapted to their environment, much better at providing for a full life style for everyone. These changes require a very significant increase in the institutions' ability to develop, support, and integrate the intellectual power of their individuals and organizations. And, as I see it, this ability will be directly dependent upon advanced application of interactive computers and multi-access computer networks. But the following condition is very strong in this "implications" picture: to harness this technology toward these ends will require intense concurrent development of our very complex and sophisticated system of concepts, conventions, methods, skills, organizational forms, attitudes, and values. It is time, and the means are at hand, to develop a much improved nervous system for our "social organisms". 8a

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TOWARD HIGH-PERFORMANCE KNOWLEDGE WORKERS

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INTRODUCTION

Among the on-line knowledge workers of tomorrow, there will be found as always a wide distribution both in personal motivation and flexibility, and in organizational roles and responsibility levels. In this view of the future, two things stand out for me: the workstations and work products of all of the workers must be interconnected; and special roles for high-performance knowledge workers within this inter-linked organizational and informational network will be extremely important. This paper outlines a framework stemming from this perception toward developing high-performance knowledge workers as part of the evolutionary strategy of a knowledge organization.

In the early 60's when I began active, funded research in this area, well before the term "Office Automation" had emerged, I referred to my work as "Augmenting the Human Intellect." (References [1] and [2] summarize events and results for me and my co-workers over the intervening years.)

About ten years ago I re-named our pursuit, after reading Peter Drucker's discussions [3] about "knowledge workers," "knowledge organizations," and "knowledge industries." It seemed that a better term for the work would be "Augmenting the Knowledge Worker." From this new perspective, a natural image emerged of a "Knowledge Workshop" as the place where a knowledge worker does his work and where, if we extended his tools, his means of collaborative communication, his working methods and his organizational roles, we could speak of an "Augmented Knowledge Workshop."

WORKSHOP ARCHITECTURE

General Features

It seems inevitable that, as depicted in Figure 1, there will be a combination of local, high-speed networking (Electronic PBX and Local-Area Network) together with higher-level networks (private and public) which will interconnect workstations and the many tools and services within an organization's "whole workshop." The effect will be as though there is a giant communication bus, where some elements seem far away (i.e., a slow or expensive communication path) and some seem very close (i.e., a fast and cheap communication path).

For the purposes of this discussion, let us put aside concerns for how much processing power and storage capacity should be built into the workstation, or where any particular programs or data should reside.

Let us instead consider the following principles, relative to supporting high-performance workers and integrating their capabilities into the larger organization:

- Their workstations should have access to many tools and services, assumedly provided by a number of distributed sources around this network, including both those newly implemented and those that have long existed and will be slow to disappear.
- The collection of tools and services for each worker must be integrated into a coherent whole into his "augmented knowledge workshop."
- Each worker should have access his full complement of tools, services, and personal working files from other workstations

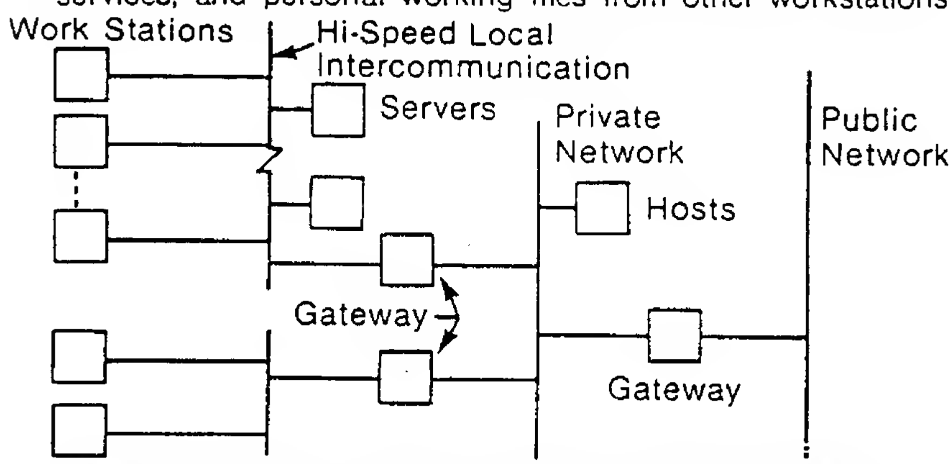

Figure 1. The workstations, computers and data bases for most large organizations will look something like this, and will connect to the outside world via at least one public network.

away from home base, even across the country so he can carry on with his work wherever he happens to be. (It would be a silly rejection of available communication technology to do otherwise.)

- This whole arrangement must provide pragmatically for continuing evolution of command language, tool and service functions, terminal hardware, processor horsepower, application packages and their support computers, etc.

  (See Reference [4] for a full development of such principles, and for the foundations for the architecture described below.)

Basic Organization of the Architecture

The over-all architectural approach that we adopted has four major components, as shown in Figure 2 and summarized below. They are all operational today as part of Tymshare's AUGMENT system.

1. A User Interface System (UIS) to handle the interface between the user's terminal and the interactive programs. (References [5] and [6] provide a detailed description of the implementation and utilization of the UIS.)

   The UIS takes care of all command-language dialog and all connection protocols. It also provides a uniform interface between the tool and the terminal to ensure that the user will (as nearly as possible) get the same treatment on a variety of terminals.

   It interacts with an individual's user-profile file, to provide interface styles tailored to the needs and preferences of that individual.

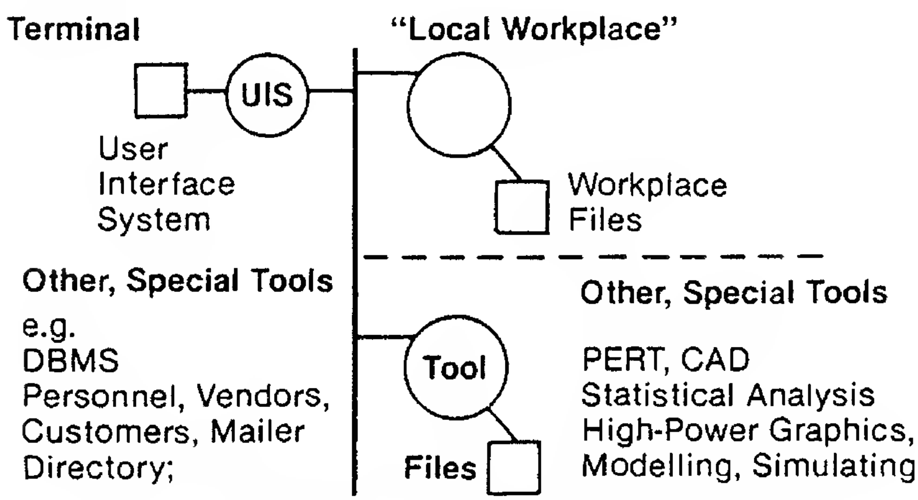

Figure 2. A user at a given terminal will "see" this kind of connection, looking "through" his UIS at his "local workplace" and beyond to the other, special tools that may be located anywhere on a connected network.

It provides a reach-through service to non-AUGMENT systems, and can optionally translate between the command language of a foreign-program modules and a command language designed to meet the user's particular needs. The user's command languages as translated for a number of different "foreign" systems can be designed for mutual consistency, to provide an important coherence in language and function.

It provides an adaptation to different terminal characteristics, allowing users to access their work from different terminals, and enabling application programmers to develop their software as though it were to serve a virtual terminal.

2. A Procedure-Call Protocol (PCP) to provide for effective communication between processes on the network. (Reference [7] gives a thorough, detailed treatment of this "PCP approach".)

   This protocol makes possible the implementation in each host of an application-independent, network run-time environment making remote resources accessible at the functional level essentially as though via a procedure call within a one-host application system. It greatly enhances the application programmer's flexibility; makes remote resources usefully accessible to other programs (not just to human users); significantly eases the problems of evolutionary changes within the network; and immensely improves the flexibility with which tools and services can be provided to the user.

3. A Core Workshop the user's own "Local Workplace," a basic collection of tools and services that a knowledge worker generally needs, regardless of his professional specialty.

   The user feels that this is his "office," where in a familiar, consistent and effective environment he can do most of his editing, studying, information management, mail management, etc. The AUGMENT Backend was designed to provide these core functions (and in addition has many features which reward a practised user with significant gains in speed and flexibility).

   The model in the user's mind is that he does most of his work here, and will "reach through" this "home workshop" to access other tools and services. There is special payoff for effective, flexible capabilities in this core workshop, where the user will spend a large proportion of his on-line time and can steadily acquire more of the available techniques toward higher performance.

4. Other Special Tools with their own file conventions, operating systems, etc.
   A rich and ever-growing mix of data bases, application programs and special services will want to be "reachable" in a coherent manner by ever-more of the knowledge workers in a larger organization especially the higher-performance workers.

It is important to support the evolutionary integration of these services into coherent, composite tools systems. AUGMENT's implementation enables application-support programmers easily to provide customized mixes of function and command terminology for special classes of users even for an individual user.

The general case, to be expected and probably encouraged, will find a variety of different hardware elements (terminals, personal computers, minis and large main frames, etc.) and a mix of software (different vintages, vendors, file conventions, terminology, user languages, help conventions, etc.).

Elements of the User Interface System

In Figure 3 are shown the main software modules (circles, ellipses) and support-file items (rectangles) involved when the User Interface System supports a user's access to a tool that is adapted for direct, "procedure call" service. The AUGMENT Backend is designed this way, and can work with full capability when the UIS and the Backend are separated by a network connection. This is true for any application system that has a procedure-call interface, regardless of the programming language and run-time environment, providing a suitable PCI module is implemented in its host computer to translate between the PCP and the particular procedure-call protocol for that application system.

The main UIS module is the Command Language Interpreter (CLI), interpreting each action by the user and responding with screen-action feedback or calls to the Backend tools for service, according to the particular Command Language in effect.

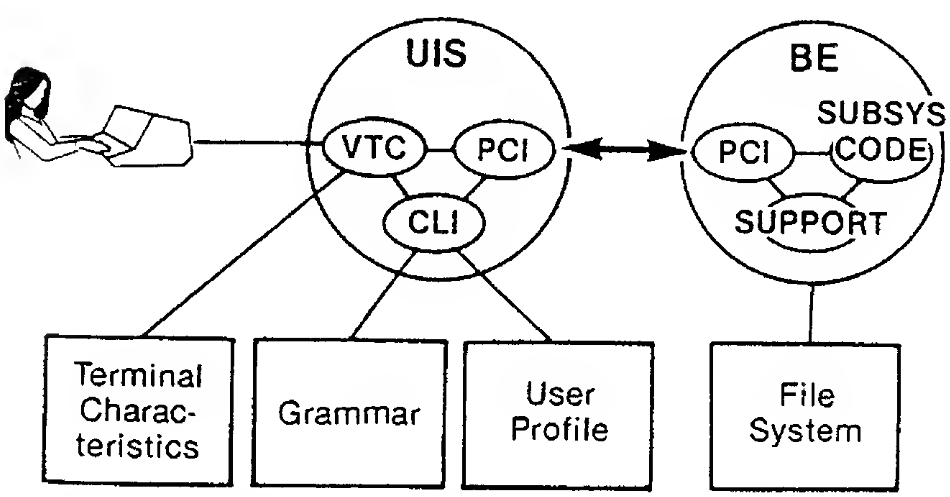

Figure 3. When using the Procedure Call Protocol to interact with a backend tool, the User Interface System (UIS) will employ three special software modules and three special control files.

There are likely to be many UIS-Grammar files lying around, each being a compact, specially coded specification of a particular Command Language. When attached to the CLI, a particular Grammar file determines the command terms and the feedback on the terminal screen, as well as the service-call and data-transfer interaction with the Backend tools.

For any given user, there will be one User Profile file attached to the UIS to specify the particular set of options which that user desires in the action of the CLI e.g., style of command recognition, amount and type of feedback, formatting defaults, initialization status, escape-code assignments to particular keys, etc.

> It is an administrative decision whether or not a particular user is provided with commands for changing his profile file.

The Virtual Terminal Controller (VTC) module lets the rest of the UIS operate as though serving a standard, "virtual" terminal, translating back and forth to/from the signals of whatever "actual" terminal is connected.

> The characteristics of the particular terminal are packed into the special "Terminal Characteristic" file one such for each different type of terminal that may be interfaced. For most of the modern terminals, this file is selected and installed automatically from interactions between the UIS and the terminal.

The UIS Process Communication Interface (PCI) allows the CLI to interact with the Backend tools making service requests and receiving the results as though it were making sub-routine calls in a "virtual" application-system environment.

> In the general case, the UIS PCI would translate the UIS signals back and forth to/from a "universal procedure-call protocol" suitable for network interchange; a particular Backend tool (application system) would employ a version of the PCI that translates in turn back and forth to/from that tool's internally employed procedure-call protocol.

Foreign-System Reach-Through

Figure 4 shows the special provision for reaching through to "foreign" systems that do not provide a procedure-call interface i.e., systems that can only be utilized by character-stream I/O as from a terminal. The Reach-Through Interface is a special module that can be programmed for the specific character-stream interactions of a given tool for eliciting from the tool the equivalent results as expected by each procedure call sent to that tool by the CLI.

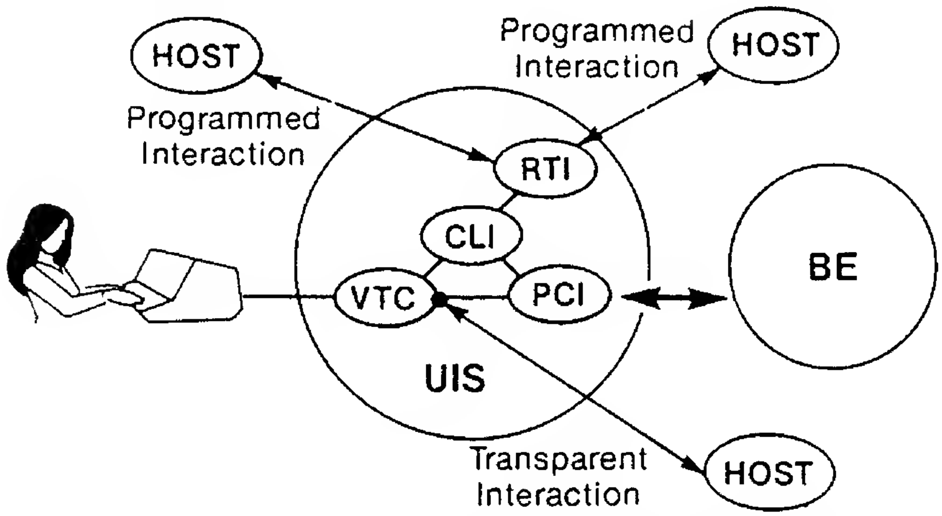

Figure 4. When interacting with a backend tool not equipped for procedure-call interaction, the UIS can employ either programmed interaction via its Reach-Through Interface (RTI), or provide the user with direct, transparent connection.

In such a case, the UIS can interact with the Backend tool as though it (the UIS) were a terminal effectively translating between the CLI and the flow of characters back and forth to/from the tool, to call for service and to receive the results.

Seemingly inefficient, yet this "programmed-interaction" reach-through mode provides for an effective translation between the command language of that foreign tool and the UIS Command Language where the latter may be designed with verbs and nouns etc. to fit the special usage and to be compatible with the rest of the grammar, vocabulary, and conceptual-model characteristics designed to serve this class of users as their coherent knowledge workshop.

This enables the coherent integration of many older systems, many of which will live on for years.

As an alternative mode of interacting with a foreign system through its terminal I/O, the UIS can connect the foreign-system link directly to the Virtual Terminal Controller (VTC) to provide interaction as though the UIS were "transparent.'

Shared-Screen Conferencing

Figure 5 shows an interconnection mode, between two instances of UIS modules, whereby both terminals can share the screen content of one of them. Each VTC module converts the virtual-terminal screen image to the correct form for its connected terminal, so this shared-screen conferencing will work for dissimilar terminals.

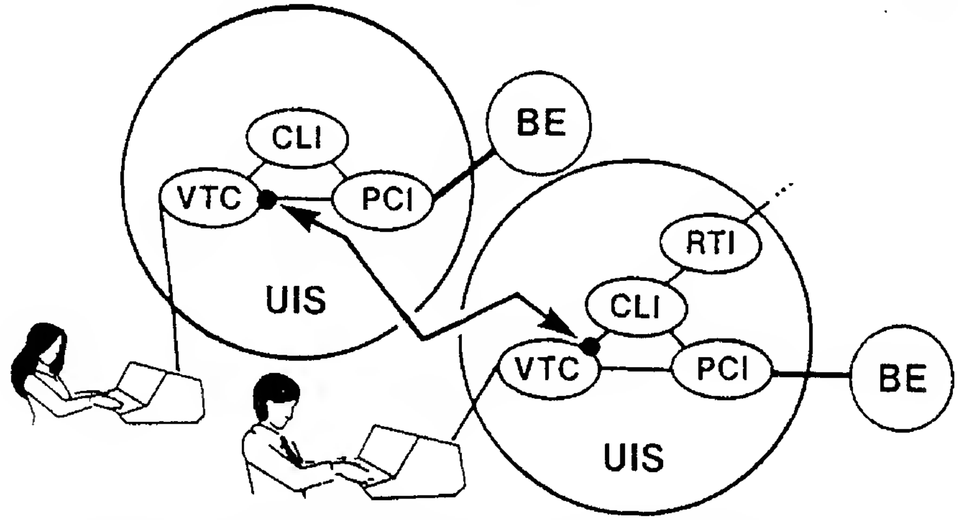

Figure 5. When employing their respective UISs in the shared-screen conferencing connection, two or more users can collaborate closely on whatever job the "showing user" has going.

This mode is established in response to a suitable set of commands by the participants, and in principle any number of users can have such a connection made to their UIS modules so that User A can in real time show the dynamic workings of his screen to them all—no matter what command language and tool system he is using.

At his option, User A can pass control to User B, thereafter what everyone watches are the effects of commands from User B's terminal and VTC acting through User A's CLI upon A's active jobs and files.

In its usual employment, this conferencing mode is used in conjunction with simultaneous telephone dialog. It will work between any two users connected by a network path. (Reference [8] gives a fairly complete description of an earlier form of this "shared-screen teleconferencing.")

THE OVER-ALL AUGMENTATION SYSTEM

The Categories of System Elements

Here, from my framework, are the major elements involved in "augmenting" our knowledge workers and their organizations. For this purpose, a "craftsman" metaphor seems directly applicable—considering that our knowledge workers must be very much the professional craftsmen.

A. Tools: Craftsmen benefit from balanced collections of well-designed tools

B. Methods: To be effective, tools must be used with well-polished work methods

C. Skills: It takes practised skill to exercise a competent blend of tool and method

D. Knowledge: True craftsmen depend upon much integrated "shop" knowledge

E. Language OF THE CRAFT: Craftsmen need an effective language to discuss, teach, plan and collaborate among themselves (i.e., to do their "shop talk").

F. Training: To develop an effective group of craftsmen in a planned way requires explicit training, in all of the above elements

G. Organization: Role differentiation and organizational structure are necessary for integrating craftsmen effectively into an organization.

Tool System and Human System

For discussion sake, call Category A the "Tool System" and the aggregate of Categories B through G the "Human System." We can immediately note that new technology, no matter how dramatic, contributes directly only to the Tool System.

Over the centuries there has been an immense amount of invention involved in the cultural evolution that brought the Human System to its present state. But its evolution took place with what will have to be described as a very primitive Tool System.

To take advantage of the absolutely radical, emerging Tool-System inventions, it is inevitable that evolution of the Human-System will begin to accelerate. In my view, this is strongly to be encouraged, since the power derived from the Tool System can only come from the way it is harnessed to human endeavors via the Human System.

Co-Evolution

The optimum design for either the Tool System or the Human System is dependent upon the match it must make with the other. There is a high degree of mutual dependence. But it seems that the Tool System is or soon will be "out of control" in the sense of our being able to design its target state, say for five years hence. And we possibly never will know how to "design" this Human System. So to be pragmatic about it, we can at best work in a "guided-evolution" mode for each of the sub-systems.

So, the ultimate capability of the larger "Augmentation System," and therefore the performance level of the knowledge workers and knowledge organizations of the future, will improve only through the co-evolution of these two sub-systems. A disastrous default mode would be for the perceptions of the technologists and the market-oriented product planners to steer the evolution of the Tool System, and leave the Human System to adapt in its trail. There is no

practical worry that the evolution of the Human System will drive that of the Tool System; it is inconceivable that the Human System could be served by analysts, inventors and entrepreneurs with the same fierce intensity as for the Tool System.

The practical worry is that there won't be enough perception of payoff from investing in explicit, conscious invention and evolution in the Human System, and that we will drift toward the above default mode.

It is something of a bind—our culture hasn't really developed an acceptance for cultural progress to anywhere near the extent it has for progress in the technological and material sense—and without a solid perception and acceptance that conscious evolution of such as this Human System (primarily a cultural matter) will pay off, we are not likely to become particularly effective at it. So it would seem that we need to invest an extra degree of attention and resource toward developing the perception that this Human System is not only acceptable but has a very high payoff. THEN we probably could get moving toward a balanced co-evolution.

SO, WHY TALK ABOUT HIGH-PERFORMANCE KNOWLEDGE WORKERS

There is a first-order answer to this question. It makes sense, at least from my viewpoint, to aim for a balanced distribution among the knowledge workers in an organization, in terms of the level of knowledge-work performance targeted for different roles. In this view then, a certain proportion of research, development and implementation investment should be made toward making really significant improvements. This would involve special attention for such roles, over both the Tool System and the Human System.

And there is also a very important, second-order answer. The most effective strategy that I can think of, toward developing the perception and acceptance of "progress" in the Human System, is to invest in pursuit of truly high-performance for selected knowledge-work roles. The best roles for this purpose would be those that would expose important stakeholders to the EXPERIENCE of truly high performance, by BEING THERE when that high performance is being exercised on activities relevant to their workaday world.

As a general strategy then, we would aim for specially equipped and trained teams to be connected into the workshop networks of large organizations, to perform roles that lend themselves best to early pursuit of especially high performance, and where there would be an appropriate visibility, identification, and sense of relevance for the organization's trend setters.

CONCLUSIONS

We can reasonably hypothesize that a startling degree of improvement may be obtained in the performance level of knowledge organizations and their individual knowledge workers. And further, that in order to obtain this we must attend to changes in both the Tool System and the Human System.

If this hypothesis were to be proven valid, it would be of immense importance for a problem-laden society to have acted on it. It doesn't seem that we would have to risk much to test it out over the next decade. A very small proportion of what is being invested in the "easy to learn" level of Office Automation, if explicitly directed toward pursuing high augmented-human performance, would have a notable effect.

Architectural features such as described above seem necessary anyway to support the natural evolution of Office Automation, even without any special emphasis upon high-performance workers. A salient point is that these features also can support the accelerated evolution of individuals and groups, who can still work effectively with the rest of the organization, but where through their own efforts or through planned investment by the larger organization they have extended more rapidly than the rest the development of their augmentation categories—tools, methods, skills, etc.

And what is also important about these features is that they provide for the harmonious co-existence, within the same organizational environment, of knowledge workers of all levels of performance. The high-performance organization of the next decade must make do with many degrees of aspiration, talent and training, and must accommodate a wide spectrum in its workers' performance levels.

And it is also important to note that architectural characteristics of the organization's knowledge workshop will have a notable effect upon the co-evolution rate of that can be achieved.

ACKNOWLEDGEMENTS

The concepts and the system described above have evolved over more than two decades, greatly aided by the research sponsorship of a number of organizations. Until 1978, at SRI International, research sponsorship by The Air Force Office of Scientific Research provided three years of critical conceptualization and planning support, from '59 through '62; DARPA's Information Processing Techniques Office, NASA, and the Air Force RADC contributed significantly until 1978, when SRI sold its rights to the system to Tymshare, Inc. There, while bringing it into the commercial market, the company has supported further conceptual and development work. During this more than two decades, probably a hundred different people have contributed directly, very significantly affecting the architecture and its implementation, and probably even affecting the way I see these things.

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COLLABORATION SUPPORT PROVISIONS IN AUGMENT

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INTRODUCTION 2

AUGMENT is an integrated system of knowledge-worker tools that originated at SRI International over an extended period under the sponsorship of NASA, DARPA and RADC. (The system was then named "NLS.") Commercial rights were transferred to Tymshare in 1978, where it has since been enhanced and marketed as an integrated Office Automation system. A short history of AUGMENT's development may be found in [Ref-1], along with a summary of system characteristics and features. 2a

The system evolved on time-shared, mainframe computers, and in a packet-switched network environment. In 1970 our computer was the second to be attached to the ARPANET, and since 1978 we have also operated extensively in the TYMNET environment. Special attributes of each the timesharing and the network environments contribute uniquely to the support of collaboration. 2b

The architecture and general character of AUGMENT were directly oriented toward augmenting the capability of humans to deal with tough knowledge work and to process effectively the large volumes of information that burden the modern office. An explicit sub-goal was to support close, active collaboration among groups of workers. In this spirit, we volunteered to develop and operate the Network Information Center (NIC) for the original ARPANET user and research community, aiming to learn about collaborative support by really doing it. 2c

Below are listed the primary community activities which we aimed to support in providing "coordinated information services for a discipline- or mission-oriented community" -- shown in the order recommended for evolutionary implementation. The rationale for the selection and ordering of these particular activities, and the approach for providing computerized support for them, were described in [Ref-2]: 2d

- A1: Collaborative Dialog 2d1
- A2: Document Development, Production, and Control 2d2
- A3: Research Intelligence 2d3
- A4: Community Handbook Development 2d4
- A5: Computer-Based Instruction 2d5

A6: Meetings and Conferences 2d6

A7: Community Management and Organization 2d7

A8: Special Knowledge Work by Individuals and Teams 2d8

The range of services conceived for this purpose had a major effect upon the system architecture and user features. However, the ARPANET user community grew much faster than was planned for, so this range had to be trimmed considerably and much less exploratory support development was carried out than was planned for. As a consequence, it was only for the first two of these activities that enough resources were available for developing significant computerized support. 2e

[Note: The NIC remained at SRI when the rest of the Augmentation Research Center left, and is healthily serving a very sizeable community.] 2f

This paper summarizes some of the principles, concepts and special provisions embodied in AUGMENT that most directly provide this collaborative support. 2g

SOME GENERAL PRINCIPLES 3

When considering an array of candidate provisions for augmenting a knowledge worker's capability for doing his individual work, the question of skill level must be faced. In working toward enhanced human capability, there seems to be no substitute for the workers' skill in the utilization of their tools. That is, assuming the best efforts of equally competent tool-system developers, the system designed to support the more-skilled workers will always provide higher human performance than the one designed to support the less-skilled workers. 3a

This principle holds true in the domain of computer-augmented collaboration also. The joint effectiveness of the collaborative group will benefit from the skills of all of the participants. And here there is a double level of skills involved: (1) skills of each person in employing computer support for doing individualized work; and (2) skills of each person at employing computer support for collaboration. The higher the group's skills at both levels, the more effective the group will be. 3b

Some collaborative provisions may be employed by skilled users to support their collaboration with unskilled users -- and in some cases, skilled users may support collaboration between other, totally unskilled people. 3c

AUGMENT TELEVIEWING 4

The remote televiewing provision in AUGMENT is an example of the latter provision, where skilled users can collaborate with lesser-skilled people, and indeed, can support collaboration between those who are totally unskilled in using the system's tools. 4a

In this mode of teleconferencing, between two or more people positioned at separated display terminals, the screen image that is being produced for one of them by whatever computer tool(s) he is currently employing can also be simultaneously displayed on each of the other terminals. 4b

This televiewing state is set up and controlled by executing commands in a special AUGMENT "Conference" subsystem. The Conference subsystem permits a user to call an on-line conference of two or more people, view and edit files, add and remove conferees, pass the gavel, and transparently connect to other tool-bearing machines via TYMNET or ARPANET. Televiewing is usually done in conjunction with a telephone connection, and is often used to support document review and revision in a synchronous mode, where all conferees can see and discuss changes as they are made. 4c

This "Conference" subsystem, as with any "tool" in the AUGMENT "workshop," will be accessed through the AUGMENT User Interface System (UIS) software module. The UIS modules serving the respective televiewing participants may be running in the same computer, or in different computers that are inter-connected by a network. (The relevant architecture which supports this AUGMENT televiewing capability is outlined in [Ref-3], along with a description of the major functions served by the User Interface System.) 4d

One function of the UIS module is to support a variety of terminals for AUGMENT use. The UIS transforms the display views constructed by the tools into a form that works for the particular type of terminal equipment employed by each user. Therefore, there may be a variety of display terminals used by the different televiewing participants as they watch the common, "shared view." 4e

Control of the tool(s) that create and manipulate this shared view can be passed from one participant to another. 4f

When simultaneously talking on the telephone, the resulting dialog becomes analogous to working around a shared blackboard, upon which individual, group, and public information can be manipulated with chalk and eraser that can be passed around among the participants. Among skilled participants, each is easily able to pull forth and share materials from his private notes or familiar reference sources and copy across into his private workplace any material offered from what the other participants may bring forth. He can demonstrate his own methods, conventions, and special skills, or demonstrate the circumstances where he has trouble and would like advice. 4g

Typical session goals include coaching, reviewing, mutual problem solving, demonstrating, etc. The more comprehensive and efficient the collective tools and skills are for doing a single individual's kind of work, the more effective these collaborative sessions can be. 4h

BASIC SUPPORT PROVISIONS: IN-FILE ADDRESSING AND EMBEDDED LINKS 5

There are a number of unique characteristics in the structure of AUGMENT files, and in the associated provisions for manipulation and viewing. Generally, their purpose is to increase the facility with which files can be studied and manipulated, and to provide for mixed media (e.g. text, graphics, recorded speech). As mentioned above, increasing each individual collaborator's ability to study and manipulate

working information will increase his ability to contribute in an augmented collaborative process. 5a

The provisions in AUGMENT for flexible and explicit in-file addressing provide collaborative benefit not only through their enhancement of individual's capabilities, but also by direct support of collaborative activities. 5b

Any given text entity in any AUGMENT file or document -- e.g. chapter, section, paragraph, word or even an individual character -- can be addressed explicitly by a string of characters that every experienced AUGMENT user can construct or read. These address strings may be optionally used in any AUGMENT command that designates an entity to be operated upon or a place in a document to do something about. 5c

Selecting that entity or place by pointing with a mouse is always an option (and almost always would be employed if that entity or place is visible on the screen). But a user always has the option of using an address string to designate an entity or place that is not being shown. That entity or place may be in in any on-line document to which that user has appropriate access rights (including documents belonging to other users or to a public pool). 5d

As an aid for specifying useful locations within a document, a user may affix a unique "name" of his own choice to any statement. When employed in an address string making it unambiguous which document is being cited, that name will serve to designate its named statement for any AUGMENT operation. Name examples: "Ref-1" names the first reference item below; and "A3" names the third activity item listed above. 5e

If an address string is enclosed by parentheses or brackets, the whole is called a "link." Examples: "[Ref-1]" is a link pointing to that item in the Reference section below; "(OAC84-Draft,3B)" would point to Paragraph 3B in the document file named "OAC84-Draft." Links may be created and edited just as any other text, and may be embedded anywhere in the text of an AUGMENT document. They are understood by a reader to be a citation that "links" this location to some other document entity or place. It is useful to consider the address in a link as specifying a path leading to the cited object. 5f

A reader who wanted to take a look at the place or entity at the other end of a link could execute a "Jump (to) Address" command and type in the corresponding address string -- whereupon AUGMENT would then change the view in a designated display window to be positioned in the designated document at the designated location. 5g

Alternatively the reader could use a "Jump (on) Link" command, and merely: (a) point to the embedded link; then (b) point to the window in which he wanted the cited passage to be displayed. AUGMENT would extract the destination address from the link (instead of expecting the user to type it) and display the referenced passage in the indicated window. For instance, when reading the text of this OAC84 document on line, an AUGMENT user could do a Jump Link on one of the reference citations (which are bonafide links) and immediately be shown the associated citation statement. 5h

A very useful, "indirect addressing" provision may be employed in a link's address string. This amounts to saying, "when your path reaches Location X, scan along the text there until you find the next link, and then follow that second link to its destination." This provision may be employed through an indefinite number of indirect links. That is, this second link at Location X may in fact contain a similar indirect-address expression -- i.e. "proceed to Location Y and follow the link you find there" -- etc. 5i

Example: "(Ref-1.1)". To follow this link, the AUGMENT Jump Link command would find the statement in this document that has been named "Ref-1" (in the Reference Section below), scan along that statement's text to the first link, "(AUGMENT,71279,)", and then follow that link. The user would be shown the opening section of document 71279 (from the AUGMENT Journal -- see below -- containing the complete text of the published document cited in [Ref-1]). 5j

SHARED FILES 6

In timesharing environments, users have grown accustomed to being able to share the use of files in the process of collaboration. Users of stand-alone workstations and personal computers generally haven't benefitted from this. The emerging wide-band interconnection options (e.g. local-area networks and public, packet networks) and the integration of file servers into on-line working environments will bring shared-file collaboration into much more prevalence. 6a

AUGMENT's architecture and general design philosophy assume this kind of working environment. Files containing the hierarchically stored information can be made available to any selected participants, utilizing a number of agreed-upon options for privacy and access. Geographical distances separating collaborators become transparent with remote computer access through networks. 6b

By employing the above-described, embedded links, these files may be interlinked to create a shared network of information. A jointly developed document for instance begins with the entry of the ideas and continues with the elaboration of the idea nodes into a narrative by each member of the collaborating team. In the case of a single product by a team effort (a proposal, report, study, etc.), agreements must be made to control access to specific files. 6c

The effect on the document as each person adds to, manipulates, and studies the common information is equivalent to passing around a paper draft for comments. But here the drafts are distributed very quickly and there is no retyping phase; the material can constantly reflect the latest modifications for all involved to see and use. 6d

Expanded, shared spaces require some retrieval support, which can take many forms. For file sharing, the use of an on-line table of contents is generally pertinent. The table of contents for public files (or private subsets) consists of lists of titles and names of files, abstract-like descriptions, with links to desired nodes in each file. The table of contents (a "locator") is hierarchically organized, permitting categorical relationships and viewing that facilitate searching the locator. 6e

Once any information is located (with one of many searching mechanisms), it is available for direct copying and integrating into any newly developing text. If

plagiarism is a concern, there are protective measures to restrict access -- but when collaboration is the intent, the free availability of information to facilitate cooperation and collaborative synergism can be much enhanced. 6f

AUGMENT automatically maintains an authorship-change record for each statement in each file, indicating the date, time, and author of the statement's creation or last change. This supports coordination among shared-file collaborators -- there are special AUGMENT provisions for viewing these records, and for scanning for statements entered or changed in a given time span or by a given author. 6g

AUGMENT MAIL 7

As a component of our overall development activity, we have made heavy use of our own AUGMENT mail system since 1970, as well as interacting with many non-AUGMENT users through the ARPANET mail systems that have emerged since the early '70s. Today, an AUGMENT user can interact with people on these other mail systems (as served by either ARPANET or TYMNET) in a uniform way, along with his AUGMENT mail interactions, from within his coherent AUGMENT environment. 7a

After thirteen years of hard-use evolution, the general features and provisions within AUGMENT Mail are probably as complete and sophisticated as any. The system provides speed and flexibility for all message-processing tasks, including composing, addressing, acknowledging, answering, forwarding, studying, and filing them. This allows our users to collaborate with high effectiveness. 7b

There is a rapidly growing availability to on-line workers of various sorts of inter-personal message handling. The general benefit to collaborative work seems well recognized. Some of the features of AUGMENT add unique benefits beyond what seems generally experienced, and are worth mentioning here. 7c

One unique source of benefit for AUGMENT Mail collaborators is that the content of a mail item is actually an AUGMENT document -- perhaps only a one-sentence document, but optionally a full-sized one. As such it carries structure, may include embedded graphics, may be directly copied into a recipient's document, etc. 7d

And another unique benefit is derived from use of AUGMENT links. For instance, a simple, one-sentence message might be, "Frank: Your comment in (Market-Bin, New-Plan, 4b3) seems to conflict directly with the boss's directive in (Division-Records, Dev-Policy, 7c)." When Frank gets the message, he can hold this passage in one display window, and via Jump Link commands, put each of the cited passages into other windows for immediate study. 7e

AUGMENT JOURNAL 8

Ongoing collaboration will benefit from provisions in addition to those for sharing files and handling mail. Dialogue implies a longitudinal series of transactions that are interrelated in various ways. For full support of task-oriented dialogue, a history of the dialogue is often valuable, and must be easily accessible through retrieval mechanisms. 8a

The history should provide a chronicle of dialog "transactions," i.e. a Journal. Within the AUGMENT system, there is provision for installing, maintaining and utilizing what we call Journal systems. A Journal system supports a recorded form of dialog having attributes similar to those provided to professional circles by the combination of their professional journals and the libraries that store, catalog and provide access to them.. 8b

Having created an on-line record of thoughts and ideas, the author (or a clerk) may direct the system to distribute it to a larger group. Such a contribution may range in size from a one-sentence message to a two-hundred-page document. 8c

In submitting this contribution a document to an AUGMENT Journal, the author specifies a title, and may include comments (analogous to a preface or other notes attached to a report). A distribution list may be specified -- using the same personal and group identifiers as for AUGMENT Mail. Other fields will be added automatically upon submission, such as date and time. Less frequently used fields provide the computer with a basis for fairly complete bibliographical handling of this dialogue item. The author is given on-line computer guidance for easily filling out the necessary fields. 8d

Upon submission to a specified Journal, the item is automatically given a number and is stored permanently in a central location. A full bibliographical citation will be generated and installed in library-like, computer-held catalogs. For each individual in the distribution list, a short citation will be delivered into his AUGMENT Mail box. One of the elements in this citation is a link pointing to the centrally stored Journal document. Using this link, a recipient may employ a simple Jump Link command to gain immediate access to the Journal document, and can study it or copy all or parts of it into working files. 8e

For example, References Ref-1, Ref-2 and Ref-3 were stored in the "AUGMENT" journal, as their Journal-reference links indicate, and an AUGMENT user with Journal-system access may still retrieve those documents from the system. There are of the order of 100,000 entries in that "AUGMENT" Journal collection -- going back to August 1970. 8f

This current document was entered as Item # 2221 into the more-recently established, "OAD" Journal collection. I exercised a Journal-system option and obtained a pre-assigned number so that I could include the number in the text of the document before final submission. Henceforth, another AUGMENT document may use the citation link "(OAD,2221,A2)" to cite the second "activity item" listed above in this document. A completely unambiguous citation, good for the indefinite future. 8g

General access to the data base of Journal documents is through an on-line catalog. Searches through the cataloged citations can retrieve citations by author, accession number, title word, or key-word descriptor. 8h

Subcollections for special groups or activity themes may be optionally maintained. Descriptors assigned at the time a document is submitted can classify it as belonging to a given "conference"; but such initial classifications needn't be restrictive, since at any later time a document may be published (in the Journal) which lists a set of

documents and/or of passages, from among the entire prior collection of Journal items, which are deemed to be relevant to a given theme. 8i

Or, a dynamic collection may be maintained by an interested party, in shared files, as a list of citations with links pointing directly to the items (documents or passages) in the Journal. 8j

No one is able to modify the centrally held Journal document -- these documents are considered to be just as permanent a record as one that has been published and put into a library. If Journal documents are not accessed for a given period of time, they are removed from on-line storage and archived on tape. Later, if given the Journal accession number, AUGMENT operations will retrieve the item from archive tapes, just as a library would retrieve from its stacks if a little-used document had been removed from the open shelves. 8k

The central storage of dialogue entries represents the recorded dialogue, including replies and cross-reference links -- essentially a network of interrelated submissions. 8l

The Journal systems provide central storage for the same reasons that libraries do: it is too costly for each individual to maintain his or her own collection; and there is need for assurance that a specified document may be provided in unaltered form. 8m

These Journal provisions encourage freer use by authors of commentary on prior entries, since an author knows that every reader has a simple means for accessing any of the earlier documents that may be cited. 8n

A new participant, entering into an established dialog process, may simply be given a relevant set of citations to be brought completely into the picture. 8o

Often, a passage in an earlier Journal document which was originally submitted as relevant only to a given theme or issue, will later be discovered by someone to be relevant to another, current issue. In this case, a new document may be entered into this newer "dialog network" that points out this relevance and provides a citation link to this old document, which now has become linked into the new dialog. 8p

ACKNOWLEDGEMENTS 9

The principles underlying this work and the basic implementation of system architecture and features were done at SRI International, sponsored by the Air Force, NASA and DARPA, and contributed to by many bright colleagues in the Augmentation Research Center. Solid enhancements have been made to the Conference Sub-system, the Mail System, and the Journal System since AUGMENT was moved to Tymshare in 1978, with many good ideas contributed out of the experience of essentially the entire Office Automation Division. 9a

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AUTHORSHIP PROVISIONS IN AUGMENT

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ABSTRACT 2

AUGMENT is a text processing system marketed by Tymshare for a multi-user, network environment. In AUGMENT's frontend is a User Interface System that facilitates flexible evolution of command languages and provides optional command recognition features. Exceptionally fast and flexible control of interactive operations is enabled by concurrent action of mouse and optional one-handed chord keyset. Files are hierarchically structured, and textual address expressions can flexibly specify any text entity in any file. The screen may be divided into arbitrary, rectangular windows, allowing cross-file editing between windows. Many options exist for controlling the "view" of a file's text in a window, e.g.: level clipping, paragraph truncation, and content filtering. Structural study and modification of on-line documents are especially facilitated. A Journal system and "Shared Screen Teleconferencing" support collaboration among authors and their colleagues. Graphic illustrations may be embedded in the same file with text. 2a

INTRODUCTION 3

AUGMENT was designed for augmenting human intellectual capabilities. It was targeted particularly toward the core work of professionals engaged in "tough knowledge work" -- e.g., planning, analyzing, and designing in complex problem domains. And special attention was paid to augmenting group collaboration among workers pursuing common goals. 3a

Authorship has received a great deal of attention in AUGMENT's evolution, as one of the central human activities to be augmented. An important set of provisions within AUGMENT -- in its architecture, design principles, and specific features -- is directly aimed toward bringing high performance to the authorship activities of knowledge workers. For the purposes of this paper, we thus speak interchangeably of "knowledge worker" and "author." 3b

We recognize explicitly that highly skilled workers in any field, and knowledge work is no exception, are those with good command of their tools. Our basic design goal was to provide a set of tools that would not themselves limit the

capabilities of the people using them. A system designed to encourage more skilled workers will always enable higher human performance than one designed to support less skilled workers. 3c

In this regard, our design goal was to provide as much capability as possible for each level of system usage skill, and a continuous evolution path between skill levels. We believe firmly that knowledge workers are motivated to grow in knowledge and skill and that provisions in system design should support this. As the rest of the paper reveals, this approach translates into a rich set of AUGMENT provisions, aimed at providing speed and flexibility for skilled workers in organizing and pursuing their core knowledge work -- in which "authorship" is a primary activity. 3d

An explicit sub-goal in AUGMENT's development was to "augment" the development, production and control of complex technical documentation -- through the whole cycle of gathering information, planning, creating, collaborating, reviewing, editing, controlling versions, designing layout, and producing the final documents. 3e

This paper concentrates upon the development phase of this cycle. AUGMENT has well-developed tools to support the later, production phase, but their discussion is not included here. 3f

Studying another's work provides a well-recognized challenge, but one of the toughest jobs is to study one's own work during its development: to see what it really says about Issue X; to see if it does provide for Concept Y; to see if it is reasonably organized and structured -- and to do these over a body of material before it is "polished", i.e., before it is well structured, coherently worded, non-redundant and consistently termed. 3g

SOME BACKGROUND 4

HISTORY 4a

AUGMENT is an integrated system of knowledge-worker tools that is marketed by Tymshare's Office Automation Division. The system was developed at SRI International over an extended period under the sponsorship of NASA, DARPA, and RADC. Commercial rights were transferred to Tymshare in 1978 (where the system has since been renamed from NLS to AUGMENT) and its evolution continued. A short history of AUGMENT's development may be found in <Ref-1>, along with a summary of system characteristics and features. The general R&D philosophy and the design principles behind AUGMENT'S development are laid out in <Ref-2>. 4a1

The system evolved on time-shared, mainframe computers, and in a packet-switched network environment. In 1970 our computer was the second to be

attached to the ARPANET, and since 1978 we have also operated extensively in the TYMNET environment. We have benefited directly from both the time-sharing and the network environments in matters that are important to the authorship process -- especially in dealing with large documents and multi-party documentation activities. In 1976-77 we conducted some applied studies for the Air Force, as reported in <Ref-3> and <Ref-4>, which concentrated upon this latter application. 4a2

RELEVANT ARCHITECTURAL FEATURES 4b

Perhaps AUGMENT's most unique architectural feature is its User Interface System (UIS), a special software module, which handles the human/computer interfaces to all interactive programs. It takes care of all command-language dialog and connection protocols, and provides a framework for building a coherent and integrated user environment while supporting flexible evolution on both sides: on the user's side, with evolution of command function and terminology; and on the technology side, with evolving hardware and software. (Design details are outlined in <Ref-5>; rationale and utilization in <Ref-6>.) 4b1

The UIS provides a reach-through service to non-AUGMENT systems, and can optionally translate back and forth to a foreign program's command language. It also supports the shared-screen, remote collaboration capability discussed below. 4b2

AUGMENT's architecture provides for open-ended expansion and flexible evolution of system functionality and worker command languages. 4b3

It is assumed that for any class of knowledge workers, specialized application systems developed by other parties, perhaps running on other computers, will provide services worth integrating. The "author class" of worker should be no exception. Continuing evolution toward the "author workshop of the future" will certainly depend upon some such features in workshop architecture. 4b4

It provides adaptation for different terminal characteristics, enabling application programers to work as though with a virtual terminal. 4b5

FILE CHARACTERISTICS 4c

AUGMENT employs explicitly structured files, with hierarchically organized nodes; each node can contain either or all of: up to 2,000 characters of text, a graphic structure, or other forms of useful data (e.g., digitized speech). The worker has a definite model in mind for the structuring of any file that he works with; in composing and modifying it he can organize and modify structure using the same verbs as for working with text strings (e.g. Insert, Replace, Move, Copy, Delete), with appropriate structural-entity nouns (e.g., Statement, Branch, Group, Plex). For any existing hierarchical structure, he

has many flexible alternatives for addressing its entities, modifying its organization, jumping around within it, and viewing it in a most beneficial manner. 4c1

(Note: AUGMENT workers generally use the term "statement" to refer to a file node, which is natural enough since the terminology became established before we added the graphic capability. Now an AUGMENT "statement" can contain either or both a text statement and a graphic diagram.) 4c2

CONTROLLING THE TOOLS 5

Many of AUGMENT's unique author-support provisions address basic operations common to almost every task, things done over and over again. These operations, executed with speed and flexibility, provide for composing and modifying one's working material, and for studying what is there over a wide range of substantive levels -- from a single text passage to a collection of end-product draft documents and their associated set of working notes, reference material, and recorded-message dialog (assuming all to be on line). 5a

In the early stages of our program at SRI, we did a great deal of detailed work on what we called the "control interface" -- how users control the functional application of their tools. These details can be very important to "low-level" interactions which are done hundreds of times during a working day. Some of these details are quite relevant to bringing high performance to the authorship process. 5b

AUGMENT commands are expressed with verbs, nouns, and appropriate qualifier words; every command word is designated by entering one or more characters. The UIS recognizes the command word from these characters according to the command-recognition options designated in each individual's "profile file." Users seem to migrate fairly rapidly to "expert" recognition modes, where a minimum number of characters will elicit recognition of command words. The fully spelled-out command words are presented in the Command Feedback Window as soon as they are recognized. The Backspace Key will cause backup, one command word at a time. 5c

Of the system requirements behind our choice of this noun-verb command form, two are particularly relevant here: (1) The "vocabulary" of the functions of the tools, and of the entities they operate upon, must be as extensible as is a natural language; (2) Textual lists of commands must conveniently lend themselves to writing, documenting, and executing as "macro" commands. 5d

Screen selection is done with a mouse. If the command's noun is a single, defined text or structure entity, e.g., a "word", then there is only one selection needed (e.g., to pick any character in the designated word). 5e

Besides using a standard keyboard for character entry, an AUGMENT user may optionally use a five-key, one-hand, chord keyset. Remarkably little practice is required in order to enter alphabetic characters, one hand-stroke per character. With less than five hours practice, a person can begin profitably working in a two-handed, concurrent mode -- operating the mouse with one hand and simultaneously entering command characters and short literal strings with the other hand. 5f

Here is an example of a low-level action which reveals some basic characteristics of high-performance execution. It is a very simple situation, but representative of what is met over and over and over again in doing hard knowledge work. The worker is composing or modifying something in one area of the screen, when his eye catches a one-character typo in another area. For a skilled AUGMENT worker, the typo could be corrected in less time than it would take someone to point it out to him -- with three quick strokes of the keyset hand during a casual flick of the mouse hand, and an absolute minimum of visual and mental attention taken from the other ongoing task. 5g

Fast, flexible, graceful, low effort -- these are important to all high-frequency, low-level, knowledge-work actions. This same kind of speed and flexibility are achieved by skilled AUGMENT workers in executing all of the other functional features described below. Description of mouse and keyset, and their concurrent employment, may be found in <Ref-7>. 5h

ADDRESSING THE WORKING MATERIALS 6

There is a consistent set of addressing features that a worker may use in any command to designate a particular structural node or some element of text or graphics attached to that node. It adds appreciably to the power and flexibility of the system commands to have a rich, universally applicable vocabulary for directly addressing particular entities within the working files. Below are some examples. 6a

EXPLICIT STATEMENT ADDRESSES 6b

There are four "handles" by which a given statement may be directly addressed: 6b1

Structural Statement Number. This designates the current "structural location" of the statement. It is assigned by the system, depending upon where the worker installs or moves a statement within an existing structure, or how that structure might have been re-organized subsequently. It is usually expressed as an alternating sequence of number-letter fields -- e.g. "1", "1a", "1a1", "1a2", and "1b". At a worker's option, these same statement numbers could be shown as "1", "1.1", "1.1.1", "1.1.2", or "1.2", but this bulkier alternative is seldom chosen. 6b2

Statement Identifier, or SID. This is a unique integer, assigned in sequential order by the system as each statement is first inserted, and which stays with a statement no matter how much its content may be altered or where it may be moved in its file structure. To make it uniquely recognizable for what it is, a SID is always displayed, printed, or designated with a prefixed "0" -- e.g., "012", "0417", etc. SIDs are particularly useful for referencing passages in a document while it is evolving. 6b3

A Worker-Assigned Statement Name (or label). For any statement or part of the file structure, an author can designate as "name delimiters" a pair of characters that indicate to the system when the first word of a statement is to be treated as a name for that statement. For instance, if "(" and ")" are set by the author as name delimiters for a specified part of the file, any parenthesized first word in a statement would be recognized by the system as that statement's name. 6b4

(Note: It is optional whether to have any of the above three identifiers displayed or printed with the statements' text.) 6b5

A Direct Screen Selection. When a statement to be designated is displayed in a window, usually the best way to "address" it is to use the mouse to position the cursor anywhere on the statement and depress the mouse's "Select" key (indicated below by "<Select>"). This mode is generally used for text manipulation -- selecting characters, words, numbers, visibles, invisibles, etc. (any of the text entities which have been made system recognizable). 6b6

MARKERS 6c

As one "holds a place" in a book by leaving a temporary place marker in it, an author can place "markers" at arbitrary locations within an AUGMENT file. When placing a marker, he attaches it to a specific character in the text and gives it a name or label. Marker names are local to each file. Simple commands provide for displaying where one's markers are located and what their names are, for deleting or moving a marker, or for installing a new one. 6c1

A marker name may be included in an address expression, to provide another way of designating an address. A marker name can designate not only a particular statement, but a specific character within that statement. For example, "Copy Word #x (to follow word) <Select>" would designate that a word located somewhere in the file and marked with an "x" is to be copied to follow the cursor-selected word. There are many unique ways in which markers may be employed by an author who has integrated their artful use into her working methodology. 6c2

As a comparative example of some of the foregoing addressing forms, consider a statement whose SID is "069", whose statement number is "3b5", that has

statement-name delimiters designated for it as "NULL" and ":", that starts with the text "Capacity: For every ...", and that has a marker named "x" positioned on one of its characters. A command to move this statement could optionally be expressed as: 6c3

"Move Statement <Select> ...", 6c3a

"Move Statement 3b5 ...", 6c3b

"Move Statement 069 ...", 6c3c

"Move Statement Capacity ...", or 6c3d

"Move Statement #x ...". 6c3e

RELATIVE-ADDRESS EXTENSIONS 6d

A sequence of characters may be appended to the address of a given statement to specify an address of a position "relative" to that statement. A major class of these designations deals with relative structural location, such as: Up a level, Down a level, Successor at same level, Predecessor at same level, Head at this level, Tail at this level, and End statement at last and lowest position in this branch. A period (".") in the address string indicates that relative addressing is beginning, and each of these relative-location designators is indicated with a directly mnemonic, one-letter designation. 6d1

For example, "Move Statement 0609 (to follow statement) 4b.dt" would move Statement 0609 to follow the tail statement of the substructure one level down from Statement 4b -- or, to conceptualize the associated address-location pathway, "go to 4b, then Down a level and to the Tail". 6d2

EMBEDDED CITATION LINKS 6e

A special use of address expressions is within an explicit text entity that we call a "Citation Link" (or "Link" for short). Links are used as textual citations to some specific file item within the workshop domain. A link is delimited by parentheses or angle brackets and contains a valid address string whose path leads to the cited file entity. For example, "(0306)" or "(4b.dt)" are valid links. Also, the reference items at the end of this paper are statements named "Ref-1", "Ref-2", etc., and as such can be cited with links "<Ref-1>", "<Ref-2>", etc. An AUGMENT reader may travel via such a link directly to the referenced bibliographic citation. 6e1

A special feature in AUGMENT's link provisions is the use of "indirect link referencing". In path-following terms, including ".l" in an address string stipulates, "scan forward from this point to the next link, and follow that link to

its target." For example, to follow the path prescribed by link "(4b.l)", one would "go to 4b, then find the first link in that statement and follow the path that it specifies." This latter path in turn could prescribe use of another link, etc. There is no intrinsic limit to the number of these indirect links that may be employed in a given path -- only a natural caution against such a path looping back upon itself. 6e2

As an example, note that "<Ref-1>" is a link to the statement named "Ref-1", a bibliographic citation at the end of this paper. In that citation, there is a link to the original source document of the referenced publication, permanently stored in the AUGMENT Journal as Item 71279 (the Journal is described below). The point to be made here is that with the link "<Ref-1.l>", I can reference the original source document -- and a Jump Link command would "take me there." 6e3

TEXT AND CONTENT ADDRESSING 6f

Other addressing options include scanning for a content match, and/or stepping backward and forward a given number of characters or words (or other text entities). For instance, the foregoing link could have involved a bit more smarts in designating which link to follow: e.g., the path for '(4b "*D" .l)' would be "to 4b, scan for first occurrence of "*D", then follow the next link found in that statement." 6f1

OTHER-FILE ADDRESSING 6g

By preceding an in-file address string with a file address, and separating the two strings with a comma, one obtains a composite address designating a given entity within a given file. Extending this principle lets one prefix the file name with a directory name in which the file is to be found; and further, one can prefix this with a host-computer name. 6g1

For example, '(Office-5, Program-Documentation, Sequence-Doc, Specifications "Journal")' specifies the path: to the Office-5 host computer, to its Program-Documentation file directory, to its Sequence-Doc file, to its statement named "Specifications", and then scan to the location of the text "Journal". 6g2

If a person were working on the Office-5 host, he would only have to specify '(Program-Documentation, Sequence-Doc, Specifications "Journal")'. If he were already working within a file with its "link default" set to the Program-Documentation directory, he would only have to specify '(Sequence-Doc, Specifications "Journal")'. And if he were already working within the Sequence-Doc file, he would only have to specify '(Specifications "Journal")'. And if he were planning to reference items relative to the Statement named "Specifications" very often, he could affix a marker (e.g., named "s") to its front and would then only have to specify '(#s "Journal")'. 6g3

Or, suppose he were working in another file in a different directory on Office-5 and wanted to reference items relative to that same "far off" statement with special ease: in some temporary place in that file he could install a statement named "Ref" (for example) containing the textual link, "(Program-Documentation, Sequence-Doc, Specifications)". He could then cite the above reference with the link, '(Ref.l "Journal")'. This path description is: go to the statement in this file named "Ref", take the first link that you find there (traveling across intervening directories and files and statements), and beginning in the statement on the other end of that link, scan forward to the string "Journal". 6g4

This is only a cursory treatment, but should illustrate well enough what is meant by "a rich and flexible addressing vocabulary." As with other high-performance features in AUGMENT, a beginner is not forced to become involved in the larger vocabulary in order to do useful work (with productivity on at least a par with some other, restricted-vocabulary system). But an AUGMENT worker interested in higher performance can steadily pick up more of the optional vocabulary and skills in a smooth, upward-compatible progression. 6h

CONTROLLING THE VIEWS 7

A user of a book, or of most on-line text systems, is constrained to viewing the text as though he had a window through which he sees a fixed, formatted document. But as described below, our worker can view a section of text in many ways, depending upon his need of the moment. 7a

MULTIPLE WINDOWS 7b

For whatever total screen area is available to the worker, his general performance will be improved significantly if he can flexibly allocate that area into arbitrary-sized windows whose contents can be independently controlled. AUGMENT has long provided this basic capability, along with the provision that material from any accessible file may be shown in any window, and also that screen-select copying or moving can be done across the different windows. 7b1

(Note: Cross-file editing can be done at any time, between any two legally accessible files. If one or the other file's material or destination is not being displayed in any of the windows, one may always opt to employ a textual address expression instead of a <Select> within any editing command.) 7b2

User-adjustable parameters are used to control the view presented on the display. Adjusting one's view parameters is a constantly used AUGMENT feature that has solidly proved its value. To facilitate their quick and flexible

use, the view-specification actions evolved into cryptic, single-character codes, called "viewspecs." The syntax of all Jump commands (used for traveling) includes the option of designating new viewspecs, and a special combination of mouse buttons enables quick, concurrent, keyset action to change the viewspecs for a given window. Here are a few of the frequently used view controls: 7b3

WINDOW VIEWS 7c

Structure Cutoff. Show only the statements that lie "below" this statement in the structure (i.e., this "branch"); or show only those following statements that are at this level or deeper; or show all of the following statements that will fit in this window. 7c1

Level Clipping. For the designated structure cutoff, show only the statements down to a specified level. Lower-level statements are "clipped" from the view; the worker can thus view just a selected number of the upper levels of his document/file. 7c2

Statement Truncation. For those statements brought into view (as selected by other view specifications), show only their first n lines. Truncation to one line is often used, along with level clipping, in order to get an effective overview. 7c3

Inter-Statement Separation. For viewing ease -- blank lines can be optionally installed between statements. 7c4

(Note: The foregoing view controls are extremely helpful when studying and modifying a document's structural organization.) 7c5

Statement Numbers and Names. Optionally, for a given window, show the Statement Number (or the SID) of each statement -- with an option for showing them at either the right or at the left margin. Independently, the showing of statement names may be turned on or off. 7c6

Frozen Statements. A worker may select a number of statements, in random order, and designate them as "frozen." One of the view-specification options is to have the frozen statements appear at the top of the frame, with the rest of that window left for normal viewing and editing. The frozen statements may be edited, or even cross-edited between any other displayed (or addressable) statements. 7c7

User-Specified Content Filters. A simple content-analysis language may be used in a "Set Content Pattern" command, which compiles a little content-checking program. One of the view-specification options will cause the system to display only those statements which satisfy both the structure and level conditions imposed by other viewspecs, and which also pass the content-analysis test applied by this program. Where desired, very sophisticated

content-analysis programs may be written, using a full-blown programming language, and placed on call for any user. 7c8

USER-SPECIFIED SEQUENCE GENERATORS 7d

In the foregoing, a "view" is created by beginning at a designated location in a document (file) and selecting certain of the the "following" statements for display, according to the viewing parameters -- possibly suppressing statements that don't pass the test of a content-analysis program. This is essentially a "parameterized sequence generator," and provides very useful options for selectively viewing statements within a document; however, it works only by selectively discarding statements from a sequence provided in standard order. 7d1

Application programmers can provide alternate sequence-generator programs, which any user can invoke in a straightforward manner. In such a case, the apparent structure being presented to the user could be generated from a sequence of candidate statements according to any rules one may invent -- and the actual views could be further controlled by the above-described viewspecs for level clipping, truncation, content filtering, etc. 7d2

Perhaps the most commonly used, special sequence generator is one that provides an "Include" feature, where specially tagged links embedded in the text will cause their cited passages to be "included" in place of the Include-Link statements, as though they were part of this file. This provision enables arbitrary assemblage of text and formatting directives, from a wide collection of files, to represent a virtual, one-document, super file. For instance, the whole assemblage could be passed to the formatter, by means of a single user action, to generate a composite, photo-typeset document. 7d3

TRAVELING THROUGH THE WORKING FILES 8

An important provision in AUGMENT enables an author to freely "travel around" in his on-line file space to reach a particular "view point" of his choice -- i.e., the position within a file from which the system develops the desired form of "view" according to the currently invoked view specifications. 8a

Traveling from one view point to another is accomplished by Jump commands, of which the simplest perhaps is a direct Jump to a statement designated by a screen selection. Then, for a worker grown used to employing address strings, a next form would be a Jump on an embedded link, or to a statement designated by a typed-in address string -- using any combination of the addressing elements and viewspecs described above. For example, the link "<4b:mI>" points to the Statement 4b, while invoking viewspecs "m" and "I" which cause the statements' SIDs to be displayed. The link "<Ref-1.l:i;LL>" points to the document referenced by the link in the statement named "Ref-1",

invoking viewspec "i" for user content filtering, and sets the filter to "LL" to show only those statements beginning with a lower-case letter. The applications are effectively endless. 8b

MODIFYING THE DOCUMENT STRUCTURES 9

Given the array of capabilities described above, it is very simple also to provide for very flexible manipulation of the file structure. For operating on a small, basic set of structure-entity nouns, essentially the same basic verbs may be used as for text manipulation -- i.e. Insert, Delete, Move, Copy, Replace, and Transpose are quite sufficient for most cases. For instance, "Move Branch 2b (to follow) 3c" immediately moves Statement 2b and all of its substatements to follow Statement 3c -- and their statement numbers are automatically changed from 2b, 2b1, etc., to 3d, 3d1, etc. 9a

A few extra verbs are useful for structure manipulation. For instance, a "Break" command will break a given statement off at a designated point in its text string, and establish the rest of the text as a new, separate statement. And an "Append" command does the reverse -- i.e., it appends the text of one or more existing statements to the end of a designated statement. 9b

A major source of structure-modification capability derives from the associated "studying" capabilities. For example, if an author can view a file (document) with specifications that show him only one line each of just those statements in the top two levels, he gets an overview of the high-level organization that helps immensely to study his current structure or outline. 9c

Concurrent use of mouse and keyset also provide considerable gains in speed and flexibility for studying and modifying document structure. For example, if when studying the overview described in the previous paragraph, the author perceives that Statement 2b really belongs in Section 3, following Statement 3c, he can execute the necessary move command in a very quick, deft manner: 9d

Keyset hand strikes "m" and "b" (for Move Branch), while the mouse hand is positioning the cursor anywhere in the text line of Statement 2b. [Two chord strokes.] 9d1

The mouse hand depresses the <Select> button on the mouse while the cursor is on Statement 2b, then moves to Statement 3c and depresses it again, and then depresses it again to say, "OK, do it." [Three button pushes, synchronized with the mouse movement as it made two selections on easy, window-wide, whole-line targets.] 9d2

(Note: I just had myself timed for this above operation -- an unhurried 2.5 seconds.) 9e

In our view, interactive computer support offers an author a priceless opportunity to get away from the geometric bondage inflicted by pages, margins, and lines -- things which have very little if any bearing upon the content and organization of one's text. In terms of value to the authoring process, we differ sharply from those who advocate a "What you see is what you get" working mode during the development of a document's content and organization. For this kind of work, experienced users of the foregoing kind of flexible facility for addressing, viewing, and manipulating structured documents, would consider a "What you see ..." mode as a relative handicap. 9f

SUPPORTING MULTI-PARTY COLLABORATION 10

The support that advanced technology can provide for close collaboration among knowledge workers is a very important and much under-rated possibility. For multiple-author activities, collaborative support is an important aspect of system capability. Some years ago, we introduced the following provisions into AUGMENT. (A more complete, overview treatment of these is given in <Ref-8>.) 10a

Electronic Mail. Its primary attributes of speed, automatic distribution, and computer-to-computer directness are well recognized -- and are generally accepted now as important to the effectiveness of knowledge workers. AUGMENT Mail has features that are beyond what most electronic mail systems offer, and which provide unique benefit to the authorship process. 10b

AUGMENT's mail system allows one to "send" complete, structured documents as well as small messages. In an authorship environment, an important role for "electronic mail" is for the control and distribution of documents -- where small, throw-away messages are considered to be but a special class of document. An author should be able to bundle up any combination of text and graphics, in the forms that he has been using for studying and manipulating them -- and send the bundle to other workers. In AUGMENT, such a bundle is just like any other file structure, and can be studied and manipulated, incorporated into other files (documents), saved or deleted. 10b1

Recorded Mail -- AUGMENT'S Journal System. When mailing a document, an AUGMENT worker may optionally specify that it be installed as a "recorded" item. In this case, before distributing the item, the system will make a permanent record if it, as a file in a specified Journal collection. And, just as though it had been published, this recorded Journal item cannot later be changed. The system assigns a straightforward accession identifier (a simple number), and any authorized worker is henceforth guaranteed access to that Journal item by specifying the name of the Journal-collection and the Journal-item number -- e.g., as specified in the link "<OAD,2237,>". 10c

A given journal may be set up to serve multiple hosts and is much like a special library. It has its collection of documents, and AUGMENT provides associated support processes for entry, cataloging, retrieval, and access. 10c1

Together with the linking capability described above, a Journal system provides an extremely effective form of "recorded dialog." Cross-reference links between a succession of Journal items produces an inter-linked network of collaborative contributions -- plans, outlines, document drafts, schedules, short comments, detailed critiques, reference material, etc. The on-line worker can follow these links very easily and, using multiple windows and flexible viewing options, can make very effective use of such records. 10c2

For instance, consider a detailed commentary directed toward a "preliminary design" document recorded in a given Journal collection. The author writing the commentary could view the design document in one window and his developing commentary document in another. He can easily establish links in his commentary to cite any passage in the design document -- e.g., a statement, a term in the statement, or a diagram. Then this author would submit his commentary into the Journal, perhaps specifying a list of colleagues for "distribution." Each listed user would automatically receive a mail item announcing this new Journal entry, giving subject, author, date, etc., and the all-important link to the new Journal file containing the commentary. Any such recipient can subsequently study both the commentary and its cited planning document in a similar, multi-window, link-assisted manner. 10c3

Furthermore, this second reader could develop and submit his own recorded commentary, which because of the citation power of AUGMENT links could be as short and to the point as: "Frankly, John, I think your comment in (DDD,xxx,aa) is a mistake! Didn't you notice the earlier assumption in (DDD,xxx,bb)? Maybe you should go back to Tom's earlier requirements document -- especially at (EEE,yy,cc)." (Here, "DDD" and "EEE" represent Journal names, "xxx", "yyy", and "zzz" represent Journal item numbers, and "aa", "bb", and "cc" represent addresses pointing to specific passages in those Journal files.) 10c4

In official parlance, "retrieval" is the finding out about the existence of a relevant piece of information, whereas "access" is the subsequent process of gaining possession of the information. For users of AUGMENT's Journal system, retrieval is immensely facilitated by the widespread use of citation links. When one can follow them as easily as can a practiced AUGMENT worker, these links provide extremely effective retrieval support. We have supplemented this with some simple, automatically generated catalog files, which made a rather nice balance. Access is provided by direct Jump on a reference link if the file is on line; if it isn't, AUGMENT asks the worker if she wants it retrieved, and a simple affirmative response automatically launches a request for the system operator to retrieve the file from its archive tape, after which the worker is notified of its availability via electronic mail. 10c5

A private document can be submitted into a Journal. In this case, only those workers listed at Journal-entry time can get access to the central copy. Such a private item would not be listed or indexed in the "public" catalogs. 10c6

We have used the Journal system very heavily since 1970 to support AUGMENT's development activity; many customers have employed it heavily since 1975. There are about 100,000 entries recorded in the original Journal now (I don't know about other, newer AUGMENT Journal collections). We found that as workers became at home in this environment, they were increasingly free about submitting their items to the "public." It became evident that the scientific tradition of active and open interchange has some solid relevance to the collaborative processes in our smaller, "colleague communities." Time and again a worker would come across others' dialog and be able to contribute some valuable information (sometimes a one-sentence comment with a critical citation link). Often the payoff went the other way: the new party found immediate value in an old piece of recorded dialog. 10c7

Shared-Screen Teleconferencing. Consider a case where two people sit down to work together at a terminal, where they can both see the screen(s), and where either one can take over the controls. This is being done countless times every day throughout the country, in different combinations of expert-expert, expert-novice, novice-coach, etc. When talking together on their telephones, two or more distantly separated AUGMENT users can collaborate in a manner very similar to this. 10d

Suppose that two workers, Smith and Jones, want to set up and operate in a Shared-Screen Conferencing mode. Smith is in Princeton, working on host Office-4, and Jones is in San Francisco, working on host Office-12 -- and both of these host computers are connected to the same network. Assumedly they are in telephone contact when they decide to work in this shared-screen mode to collaborate on Smith's current job. 10d1

Jones will enter the command "Share (display with user) SMITH! On host OF12! Viewing (other display)!!" 10d2

Smith will enter the command "Share (display with user) JONES! On host OF4! Showing (this display)!!" 10d3

To give these commands, each person only entered the characters shown in upper case (entry case actually irrelevant), plus the digits, plus an "OK Key" action where each exclamation point is shown. 10d4

Whatever tool that Jones is currently using will continue responding to his controlling actions, as evidenced by various feedback and portrayal actions in the windows on his screen. Smith's screen image will clear, and be replaced with a replica of Jones' screen image -- multiple windows and all. For the duration of the shared-screen session, Smith's screen image will continue to replicate what is shown on Jones' screen. 10d5

There are provisions for passing control back and forth between workers. For instance, Jones can pass control to Smith so that Smith can show him some material or method of work. There are also provisions for the subsequent entry and departure of other conference participants. 10d6

EMBEDDING THE GRAPHIC ILLUSTRATIONS 11

For complete support of document development, it is important to provide integrated means for developing, viewing, and manipulating graphical portrayals. These portrayals should be part of the working files from the very start, to be studied, passed about in mail, shared in Conferencing mode, edited, captioned, labelled, and moved about within the document structure. Furthermore, active, relevant citation links pointing to these graphical constructs would be installed in and followed from textual passages throughout the associated set of documents (including Mail and Journal documents). 11a

AUGMENT's architecture and file structure were designed for this end, and a good bit of the associated implementation is in place. 11b

A graphical data structure can be attached to any given file node, and there are basic capabilities for composing, studying, and modifying graphical diagrams. When formatting for a suitably equipped photo-typesetting device, there are formatting directives to designate the position and scale for placing these diagrams on a page. An AUGMENT file with integrated text and graphics can thus be mapped automatically onto a high-quality document whose pages contain both text and line drawings. 11c

Our goal here was for what we call an "illustrative graphics" capability -- basic to which is a command that, when directed toward any conventional "plotter" file, will translate it into a diagram attached to a designated node. In this way we can make use of graphic constructs developed within almost any applications system, most of which have provision for outputting "conventional" plotter files. 11d

The most important next step is to adapt a bit-mapped display as an AUGMENT workstation, so the integrated text and graphics can be viewed and manipulated on the same screen. Heretofore, to do graphic work, an author has had to attach a Tektronix 4014 storage-tube display to the special printer/graphic port of her AUGMENT workstation. This has made use of AUGMENT graphics slow and expensive enough to limit the number of user groups who have developed the integrated use of mixed text and graphics. 11e

CONCLUSION 12

AUGMENT's unique provisions stemmed for the most part from the conceptual framework within which AUGMENT was developed. For instance, consider the pervasive and significant changes in the environment in which humans will be doing their knowledge work. Note that the habits, methods, conventions, intuitions, etc., that comprise the "ways" in which we think, work and collaborate, are for the most part products of many centuries of cultural evolution -- in a radically different environment. With a radically different environment, this constant process of cultural evolution can be expected to take some radical turns. 12a

The AUGMENT developmental framework assumed that many of these "ways" are candidates now for change in directions that heretofore would not have been beneficial. The AUGMENT system emerged as a first step in considering a few such changes, which perhaps can improve human capability for doing knowledge work because their new "ways" will enable us more effectively to harness the new tools toward more effective basic capability. (This is very different from trying to "automate" our old "ways" of doing things.) 12b

As an example, consider the "What You See Is What You Get" (WYSIWYG) syndrome. It is a highly touted feature for many vendors. It provides a definite advantage for the final process of converting a computer-held document to a nicely formatted hard copy. But what does it do for authorship? Well, in our framework, it has a negative impact. We were happy to abandon those constraints of lines and pages and other formatting geometry which did not contribute to matters of content and structure. We have chosen instead to provide the authorship process with structured files, flexible addressing, flexible window-size viewing, level and truncation viewspecs, etc. -- things that would be awkward or impossible to provide in a WYSIWYG environment. This provides the authorship phase with flexibility and power for studying and manipulating content and structure that we wouldn't consider trading off for WYSIWYG. Save it for the production phase. 12c

Here is another bit of culture that deserves re-examination. Consider the dictum, "Easy to learn, and natural to use." Or, "User friendly." The question is, for whom are you judging that things will be easy, or natural, or friendly? For designers of craft-work tool systems, very different perceptions of this issue are warranted between a system for the occasional, weekend do-it-yourself person and a system to be heavily used day after day by professionals. The AUGMENT User Interface System enables us easily to configure either kind of a tool collection. 12d

This paper describes part of what is provided to professional knowledge workers who do a significant amount of authorship work. We observe no more difficulty in their learning how to employ this relatively large collection of tools

than one would expect for professional woodworkers in their learning about the relatively large collection of chisels and other tools of their trade. 12e

It is a basic part of our framework that, to augment human knowledge workers, attention must be given not only to tools, but to methods and skills as well. Because of space limitations, the scope of this paper was restricted to a summary of those tool provisions within AUGMENT that especially facilitate the authorship process. A full description of "How to use AUGMENT to ..." would definitely need to include methods of work that effectively harness these tool provisions, and the special kinds of skills that yield unique payoff in executing these methods. This is true for every tool system, of course, but it seems especially true in this case because many AUGMENT provisions do not fit into the general cultural background of our authorship process. 12f

Perhaps the best way for very brief summarization of what AUGMENT's users feel about its unique features is simply to say that those who leave its working environment really miss them. 12g

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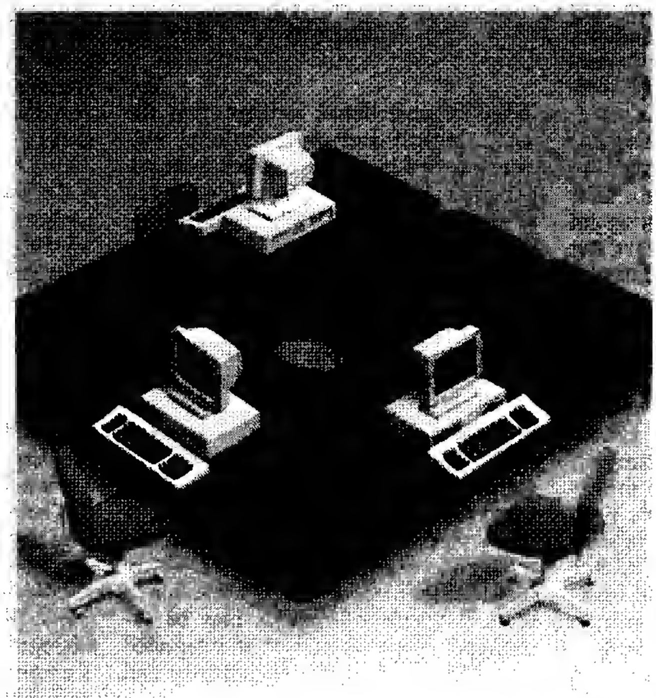
Working Together

The "human system" and the "tool system" are equally important in computer-supported cooperative work

Douglas Engelbart and Harvey Lehtman



The emergence of the personal computer as a major presence in the 1970s and 1980s led to tremendous increases in personal productivity and creativity. It also caused setbacks in the development of tools aimed at increasing organizational effectiveness—tools developed on the older timesharing systems.

To some extent, the personal computer was a reaction to the overloaded and frustrating timesharing systems of the day. In emphasizing the power of the individual, the personal computer revolution turned its back on those tools that led to the empowering of both co-located and distributed work groups collaborating simultaneously and over time on common knowledge work.

The introduction of local- and wide-area networks into the personal computer environment and the development of mail systems are leading toward some of the directions explored on the earlier systems. However, some of the experiences of those earlier pioneering systems should be considered anew in evolving newer collaborative environments.

Computer Supported Cooperative Work (CSCW) deals with the study and development of systems that encourage organizational collaboration. Most groupware products fall under this classification. CSCW projects can be classified into three categories: tools for augmenting collaboration and problem solving within a group geographically co-located in real time (e.g., CoLab at Xerox Palo Alto Research Center); real-time tools for collaboration among people who are geographically distributed; and tools for asynchronous collaboration among teams distributed geographically.

In our work at the Augmentation Research Center (ARC) at the Stanford Research Institute (SRI) International beginning in the mid-1960s, we developed a system called NLS (On-Line System) and tools that supported these forms of collaboration. However, we placed the greatest emphasis on collaboration among people doing their work in an asynchronous, geographically distributed manner.

Our original goal at ARC was to "augment" individuals doing knowledge work. (See the text box "The NLS/Augment Architecture" on page 247.) In fact, some of the tools, techniques, and artifacts we developed then have become widely used in personal computer environments. These include full-screen windowed editing systems, mouse-controlled cursors, hypertextual linking of documents, and consistent user interactions across all aspects of a system. As timesharing systems and then wide-area networks (such

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as the ARPANET) were introduced, the domain we attempted to augment widened to include groups collaborating in the same place, as well as over distances bridged by the networks and over time bridged by tools for creating a recorded dialogue among the collaborators.

One of the key strategies at ARC was the notion of bootstrapping: making use of available technology to create tools, techniques, and methodologies for knowledge workers in general, and the ARC group in particular, to use in further development of the tools. We served as the developers of the technologies, as well as the subjects for the analysis and evaluation of the augmentation system we had been developing. Many of the surface features of the system appeared in fancier dress as bit-mapped graphical hardware that became available first at Xerox, then later, much more widely, at Apple.

While it was exciting to see bits and pieces of the original NLS, now called the Augment system, appear commercially over the years, many elements of the system's conceptual core have only recently been recognized: outline editors (for easy manipulation of ideas); hypertextual linking capabilities fully integrated into the system; a system of recorded group dialogue that transcends most mail systems; user programmability and customizability of the system; and, most important, tools for augmenting not just individual knowledge workers but also teams of people both coresident and distributed over the world interacting through a networked environment.

We thought that success in creating tools for collaborative knowledge work was essential to the necessary evolution of work groups in increasingly knowledge-rich societies and to increasing organizational effectiveness. Until the recent growing interest in CSCW, most developers limited their analyses to technical issues and ignored the social and organizational implications of the introduction of their tools; such considerations were, however, key to our work.

There is growing recognition that some of the barriers to acceptance of fully integrated systems for augmenting groups of knowledge workers may be more significantly social, not solely technical. The availability of rapidly evolving new technologies implies the need for concomitant evolution in the ways in which work is done in local and geographically distributed groups.

ARC experienced this phenomenon continuously. The bootstrapping approach, so important to the continuing evolution of the system, caused us to constantly undercut our world: As soon as we became used to ways of doing things, we replaced platforms to which we were just becoming accustomed. We needed to learn new roles, change attitudes, and adopt different methods because of growth in the technological system we ourselves produced.

We brought in psychologists and social scientists to serve as observers and facilitators. They were as important to our team as the hardware and software developers. The resistance to change, which we soon realized was an essential part of introducing new technologies into established organizational settings, and the psychological and organizational tensions created by that resistance were apparent in ourselves. We were required to observe ourselves in order to create appropriate methodologies and procedures to go along with our evolving computer technologies.

We brought in psychologists and sociologists to serve as observers.

Our lab was concerned with *augmentation*, not automation. The choice of this term was significant. Aspects other than introducing new technological tools into the workspace (e.g., conventions, methods, and roles) are at least as important to the success of any CSCW system. The elegant tools available now and in the future—superlative graphics, artificial intelligence services, and so on—only make sense in an integrated workshop of tools in which information may be exchanged. The tools in such an integrated workshop need to be conceptually and procedurally consistent.

We expect that as tools are introduced and used, a co-evolution will occur between the tools and the people using them. Thus, WYSIWYG systems eased the acceptance of computer systems by nontechnically oriented users; however, these systems produce a map of what you would see on paper as opposed to a hyperdocument with structural links evolving over time. We are now seeing the increasing acceptance of other presentation metaphors (such as Apple's HyperCard and Owl International's Guide) incorporating some of the nonlinear linking capabilities that were present in Augment.

The architecture and character of Augment were directly oriented toward augmenting the capability of humans to deal with tough knowledge work and to process effectively the large volumes of information with which knowledge workers must deal. A subgoal was to support active collaboration among groups of workers. To gain experience with the issues and needs associated with this support, we developed and operated the Network Information Center (NIC) for the original ARPANET user and researcher community.

Creating a Collaborative System

The following elements are necessary ingredients in a system designed to support collaboration in a community of knowledge workers. The sequence represents an explicit progression that begins with tested techniques whose "cultural shock" and financial investment are relatively low; it proceeds through paced, open-ended evolution with time, experience, and perceived payoff toward tools and techniques that involve a greater investment in both financial and social areas.

• *Collaborative dialogue.* Computer tools for the composition of messages and for their subsequent reviewing, cross-referencing, modification, transmission, storage, indexing, and full-text retrieval are a necessary part of a CSCW system. A "message" in such a system can be of any length. It can contain formalized citations pointing to specific passages in prior messages, so that a group of related messages becomes a network of recorded-dialogue contributions.

There should also be automatic message delivery; full cataloging and indexing; on-line accessibility both to message notification and to the full text of all messages; and open-ended storage of the dialogue records. These services enable a community of people who are distributed in space and time to maintain effective, recorded, collaborative dialogue in a manner that qualitatively differs from most ordinary electronic-mail systems.

With Augment, real-time remote dialogue (teleconferencing) was supported by a "shared screen" facility through which users could "link up" their displays; each party to the link sees a common display view. Any party to the link is able to point to or control or execute

continued

The NLS/Augment Architecture

The On-Line System, or NLS, was designed to support members working in varied disciplines, including software engineers, managers, and social scientists. There were core tools used by all these knowledge workers, as well as specialized tools developed for particular requirements. All the tools shared the commonality of design principles that we thought essential to the success of what we termed a knowledge workshop. Early development began in 1963 and proceeded until 1976. (See photo A.)

The physical environment on which Augmentation Research Center (ARC) members (and collaborators across the country) worked evolved along with our system and externally available technologies. Back when the project started, display technologies were extremely primitive: Most people were still using punched cards and paper tape. Few computer users had direct access to a computer.

A Revolutionary Console

In that context, the NLS terminals were especially revolutionary. The display consoles were equipped with typewriter-like keyboards, a five-finger keyset for one-handed character input, and a mouse, invented in our lab, for cursor control (see photo B).

The keyset was useful for most members of ARC, as commands were generally recognizable by single-character mnemonics, with appropriate feedback provided by the system. Most team members became proficient at one-hand text input, leaving the other hand available for cursor control by means of the mouse as they moved through the information space on their terminal screens.

Initially, screens were generated on small CRTs in our machine room and transmitted via closed-circuit television to the ARC workstations. Later on, as character-based displays became commercially available, we created external boxes to those terminals for attaching mice and keysets and controlling the cursor and screen updates in the manner required by our essentially nonlinear system devices, which were developed principally as "glass teletypewriters."

Those boxes, or line processors, were eventually made available to users over the ARPANET so they could experience the display-based version of NLS. However, because of the initially limited availability of displays, we also created a typewriter version of the system (TNLS), which had a complete mapping of the display NLS (DNLS) interface and permitted ready access to information across the country through the then more cost-effective typewriter terminals.

NLS was the core workshop software application system. It centered around the composition, modification, and study of structured textual material. Graphics were available in a primitive manner on the early terminals; the later line-processor-based systems made graphics available on additional, external graphics displays.

The type of bit-mapped graphics systems and hard-copy printers readily available today were not available to us at the time, although later evolutions of our file-system content architecture could accommodate graphical entities as data nodes. Moreover, there were important areas associated with the text domain that needed exploration.

A Hierarchical Structure

The underlying NLS document architecture was hierarchically structured; the structure of a file was separated from its content. Originally, content nodes were strictly textual in nature; eventually, each structural node referred to a property list of content nodes of varying types, including other hierarchies (i.e., text, graphics, code, and so on).

The structure made for rapid navigation through the information space created by a file or collection of files. Its complexity was hidden from novice users (who didn't need to know about its implementation and, in fact, could ignore the hierarchy if they wished as they created linear documents in the NLS editor).

However, more sophisticated users

continued

Photo A: *A 1967 augmented meeting. This configuration is similar to more current sustems, such as Xerox PARC's CoLab.*

could address any point in any file throughout a network via a link—a syntactic address, which could be embedded anywhere in other files. These links were essential to the first implementation of the sort of system later called hypertext by Ted Nelson. (See the October BYTE.)

The basic node in an NLS file was a statement, most often used to represent a paragraph in text, a line of code in a program. The user could impose filters on the content or structure through tools either built into the system (view specifications) or installed through a user-programming facility. Thus, users could look at a particular number of lines of those statements at a particular level in a file. This facility was similar to those in so-called idea processors, such as Living Videotext's More. Associated with each statement was the date and time of its last edit as well as the identifier of the community member who created or edited it. Document filters over authors and time could also be installed.

Because of the collaborative nature of the development of NLS, there were tools and conventions for group authorship. Only one person could have write-access to a file at a time. Other team members could have read access to the file, minus the edits currently being made. A lock was placed on a file being written; if another team member accessed the file or attempted to write on it, that person would be told who had the file locked.

A Variety of Tools

NLS had tools for moving through the information space, using the mouse to select locations on the screen or the addressing capability (using the link syntax) to specify locations not directly accessible from the screen. You could jump to locations related to structural entities (successor, predecessor, and so forth), or you could jump via links by pointing to a textual link in a file or typing one in when prompted. Users could have up to eight windows on a screen with different files or different parts of the same files visible. Material could be copied across windows.

Programmers had access to a number of languages we created: Tree Meta, a compiler-compiler, was used to bootstrap us onto different machines (XDS 940, PDP-10, PDP-11, and DEC 20) and to create the other compilers and assemblers we used. L10 was a block-structured language with pattern-matching and string-construction facilities. The same pattern-matching syntax was used by less sophisticated users to generate filters in the core workshop. The Command Meta Language (CML) was used to create user interfaces that were independent of terminal type (display or typewriter) and individual user preferences. CML grammars were interpreted. Contextual entries into syntactic and semantic help systems were generated from the CML grammars. The Output Processor interpreted a comprehensive document-formatting language.

Programmers could look at procedures on the display and, encountering a reference to another procedure, jump to it. If it was not within the currently open file, the jump took place indirectly through a procedure catalog automatically generated by the automated program librarian.

The program librarian operated over system databases at night (or whenever it was invoked). If a code file had been modified, it would be automatically compiled; if all compilations took place without error (errors were recorded in other NLS files), a new system would be linked and created. The catalog was sorted alphabetically and, in addition to links to the files containing the procedures, included comments and calling sequences that were extracted from the procedure.

Programmers could view and modify procedures, compile them independently into their own address spaces, and automatically "replace" the existing versions of the procedures in the system to try out variations. Users could install (automatically when entering the system) alternative versions of standard system procedures. A symbolic debugger could be called up in a separate window, and breakpoints could be set by pointing at procedure names in the source-code file with the mouse.

We had tools for creating recorded dialogues with other users: Our Journal provided the usual message-passing facilities available on other timesharing and networked systems. However, we

Photo B: *A display NLS workstation with video overlay. Note the chord keyset input device used as a supplement to the keyboard. (The mouse may be seen in the video overlay on the screen.)*

could also submit larger documents or parts of them for permanent storage and retrieval or for the information and collaboration of other users. Shorter messages could be transmitted directly to a user's Initial File (the file seen on entering the system, similar to the desktop on current systems). Citations to larger documents would be delivered.

On seeing one of those citations, which included links to the document's location in the Journal, a user could jump to that document. The documents in the journal were permanent, read-only records of the dialogue within the community. Links to these documents were created, and evolving commentary on the design and implementation issues were always available. These facilities are similar to those currently advocated as "hypertext publishing systems."

NLS also had tools for interactive real-time collaboration. For example, users could link their terminals together and share screens; this made it possible for them to view the same material and collaboratively edit it.

As the ARPANET became available, we were among its first users. We found it necessary to tune the network to the then unique characteristics of our highly interactive system. It was also useful to separate the architecture of the system into a front end (which handled the user-interface interactions) and a back end (which handled the execution of commands).

The front end could operate on a separate machine and communicate with back-end resources through a network. Commonly used resources could be resident on the front-end machine; resources that were most usefully shared would reside on the back end.

We also created the Network Information Center (NIC) at the Stanford Research Institute to serve as an information resource for the emerging ARPANET. We used our tools to create the ARPANET Resource Directory, which was made available in both on-line and hard-copy form.

NLS included facilities for document development, production (including early computer phototypesetting facilities), and control. These facilities incorporated tools for successive refinement and editing by teams of writers, editors, and reviewers and were built on other parts of the core workshop, such as the editor, Journal, and programming tools.

any of the capabilities of the workshop. Such capabilities assume a high degree of responsiveness and bandwidth in the communication channel in order to support the high degree of interactivity in the system. (Our developments in this area required extensive tuning of the original ARPANET algorithms.)

• *Document development, production, and control.* This system capability includes tools for composing, studying, and modifying document drafts and for high-quality photocomposition. In addition to the page-layout tools that have become widely available, Augment offered tools for collaboration between several authors and editors in the process of evolving a final draft. These included tools for controlling changes, new version distribution, and automatic index generation for complex documents or sets of documents.

Page-layout programs such as PageMaker have entered widespread use in recent years. However, the tools for collaborative control of other aspects of a document's evolution are equally important. Augment permitted establishing superdocuments that were hypertextually linked combinations of the whole or parts of many pieces of information. This linking implies and reflects underlying meaning in ways that mere typesetting, which deals primarily with layout, cannot. While the typeset, WYSIWYG view should be available, it should not be the only way to view a document in its larger sense.

We also assume the need for tools to authenticate submissions and comments, provide administrative support to editors, offer sequential delivery and tracking for approval chains, and show automatic "ticklers" to those who do not respond to requests for comments, modifications, and approvals.

A backlinking facility within the recorded dialogue system is also necessary to handle superseding of old documents by new. Recent versions of the Augment Journal provide such a capability, permitting users to request current or older versions of an evolving document.

• *Research intelligence.* The tools within the Collaborative Dialogue Support System for cataloging and indexing internally generated items should also support managing *externally* generated items—bibliography, contact reports, clippings, notes, and so forth.

With centrally supplied (and hence uniformly available) services such as these, a community can maintain a dynamic and highly useful "intelligence" database to help it stay up-to-date on external happenings that affect it. Citations of external items from within the internally generated dialogue base, in the form of annotations, commentary, or supportive references, offer computer-sensible interlinking of the external information with the internal information and facilitate browsing, retrieval, searching, back-citation, and so on.

• *Community handbook development.* This includes extending this research service toward the coordinated handling of a very large and complex body of documentation and its associated external references. This material, when integrated into a monolithic whole, may be considered a "superdocument." Tools for the responsive development and evolution of such a superdocument by many (distributed) individuals within a discipline- or project-oriented community could lead to the maintenance of a "community handbook," a uniform, complete, consistent, up-to-date integration of the special knowledge representing the current status of the community.

The handbook would include principles, working hypotheses, practices, glossaries of special terms, standards, goals, goal status, supportive arguments, techniques, observations, how-to-do-it items, and so forth. An active community would be constantly involved in dialogue concerning the contents of its handbook. Constant updating would provide a "certified community position structure" about which the real evolutionary work would swarm; flexible tools for on-line navigation and view generation would be very important, as would the facility for generating hard-copy equivalents.

The "handbook cycle" includes the incorporation of ongoing dialogue and intelligence mediated by professional facilitation to create evolved versions of the community handbook.

• *Computer-based instruction.* We assume that the special training needs of a community of collaborating knowledge workers will be supported by computer-based instructional tools. These would make use of the other knowledge workshop services described, especially dynamic filtering of the community handbook.

A "shared screen" facility is useful for instruction so novices can get access to expert users or coaches in parts of the system for which other instructional tools are inadequate and for which local teachers are unavailable. Having an expert take you along for a ride is an extremely effective learning technique.

continued

• *Meetings and conferences.* At ARC, we made extensive use of augmentation tools in our local and distributed meetings. Projected display images, video overlays, and split-screen image superimposition were first used to great effect by Engelbart in the 1968 IFIP Fall Joint Computer Conference in San Francisco.

Dynamic control of the agenda and the collaborative creation of position papers are some typical uses of these services.

• *Community management and organization.* Conventional project-management operations can be augmented through the use of computer-based project-management tools with the enriching services of dialogue support, document development, and the handbook, which would include plans, commitments, schedules, and specifications.

• *Special knowledge work by individuals and teams.* The tools supporting a collaborating community should be available to the team members in their roles as individuals and members of other teams. A user-programming facility in Augment made it possible for individual users to customize parts of the system according to their needs and abilities. Some of these specialized extensions became part of the more widely available tools for the entire workshop community.

A Formula for Success

As Augment evolved, we realized some assumptions that we think are applicable to any successful CSCW system:

• *Coordinated set of user-interface principles.* There should be a common set of principles over the many application areas. This does not mean that the user interface itself is necessarily the same across all domains. It does mean that a common underlying style of communication is present. While each domain within the core workshop area or specialized application system may have a vocabulary unique to its area, this vocabulary should be used within language and control structures common throughout the tool environment. Users learn new functions by increasing vocabularies, not by learning separate "foreign" languages. When in trouble, they will invoke help or tutorial functions in a standard way.

This point has become apparent in the Apple Macintosh environment. Users of different applications have a common method of interacting with each application. This makes it easier to learn new applications and to move between systems.

A single interface metaphor is neither required nor ideal. Interaction styles suitable for a particular application domain and user group may differ from those for other domains and users. Apple's HyperCard provides an example of an environment that offers interaction metaphors different from the original Apple Desktop with minimal confusion to users.

• *Grades of user proficiency.* Users who are not experienced in using the system are part of the community; they will want to be able to get at least a few straightforward things done with a minimum of learning. Even an expert user in certain domains of the collaborative workshop environment will be a novice in less frequently used domains. Attention to novice-oriented "easy to use" features is required.

However, users should be rewarded for their increasing proficiency with a rich tool environment that offers advanced vocabularies and the opportunity

continued

for individual customization in every specialized domain.

• *Ease of communication among, and addition of, workshop domains.* We think that there will be many different parts of an augmented-knowledge workshop, each with its own tools. You should never be bound to isolated areas of the workshop. It should be possible to move and communicate information between domains easily. It should also be possible to install new tools as needed.

• *User-programming capability.* Users must be able, with various levels of ease, to add or interface new tools and extend the language to meet their needs. They should be able to do this in a variety of programming languages in which they may have training, or in the basic user-level language of the workshop itself (e.g., through a macro facility.)

We can't ignore the social implications of our technical progress.

• *People-support services.* The computer-based tools will be insufficient by themselves. The CSCW technologies will create opportunities and needs for highly specialized professional services, such as database design and administration, training, cataloging, and retrieval formulation.

• *Recognition of standards for information interchange and ranges of hardware.* We should not have to assume the presence of a particular type of machine in a user's work environment. It should be possible to exchange information and get a reasonable representation of the information shared across system environments.

• *Careful development of methodologies.* The elements involved in augmenting communities of knowledge workers include the development of both "tool systems" and "human systems" (the set of skills, methods, languages, customs, procedures, training, and organization structures needed for effective use of tools). New technologies, even those such as CSCW that aim at improving group interaction, contribute directly only to the tool system. The cultural evolution that led to the current state of the human system took place with a very primitive tool system.

As much care and attention needs to be paid to developing the procedures and methodologies associated with the people-support services and the organizational and societal effects of introducing new technologies as is spent on developing the technologies themselves.

• *Co-evolution of roles and organizational structures and technologies.* The widespread availability of successful CSCW services will create the need for new organizational structures and roles. These structures and roles need to co-evolve with the technologies. For example, we found there was a need for what we called knowledge-workshop architects who served as "change agents" in introducing new technologies into their organizations.

To take advantage of the radical, emerging tool-system inventions associated with CSCW, it is inevitable that the evolution of the human system will begin to accelerate. The optimum design for either a tool system or a human system is dependent on the match it must make with the other. The high degree of mutual dependence implies that a balanced co-evolution of both is necessary. The bind we are in is that our society encourages and rewards progress in the technological and material sense and often ignores the human and social implications of that progress. ■

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Douglas Engelbart, a senior scientist at McDonnell Douglas, recently created the Bootstrap Institute to further CSCW research. Harvey Lehtman is manager of the New Media Group at Apple Computer. They can be reached on BIX c/o "editors."

KNOWLEDGE-DOMAIN INTEROPERABILITY AND AN OPEN HYPERDOCUMENT SYSTEM

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Document #: (AUGMENT,132082,)

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INTRODUCTION 1

This paper anticipates that the tools and methods of computer-supported cooperative work (CSCW) will become harnessed with revolutionary benefit to the ongoing, everyday knowledge work within and between larger organizations. Toward that end, the following concerns about interoperability between knowledge-work domains will have to be met, and something such as the "open hyperdocument system" must become available for widespread use. 1a

As computers become cheaper and we learn more about harnessing them within our cooperative work, they will come to support an increasing number of different domains of knowledge work. Moreover, the sphere of computer-supported activities within each domain will steadily expand as more function and more skill become employed. 1b

It is predictable that increasing functional overlap will occur as these expanding domains begin to overlap. It has become apparent to me that someday all of our basic knowledge-work domains will be integrated within one coherent "organizational knowledge workshop." This leads to thinking about an over-all, integrated architectural approach to the ever larger set of common knowledge work capabilities emerging within a multi-vendor environment. 1c

Much has been accomplished to date in standards and protocols in the highly active field of networked workstations & servers, where "interoperability between hardware and/or software modules" has become a central theme. 1d

This paper considers the "interoperability between knowledge domains." This interoperability theme will be increasingly important for a workable CSCW framework as the scope and degree of CSCW increases. Dramatic increases will predictably create a marked paradigm shift about how to organize and operate cooperative human endeavors. I think that two phenomena will yield changes and a paradigm shift that will make this interoperability of paramount importance: 1e

(1) With a relatively unbounded technological frontier together with immense and growing economic pressure, the speed, size and cost of computers, memory, and digital communications will continue improving by geometric progression; 1e1

(2) Awareness and importance of CSCW is emerging, with a predictable trend toward our doing more and more of our personal and cooperative knowledge-work online. 1e2

Assuming an inevitably gigantic scale for our inter-knit "CSCW world" provides some important guidance for the continuing investment of our business resources and professional time. 1f

For one thing, each year earlier that an effective degree of knowledge-domain interoperability is in place within important organizational or institutional domains could be worth hundreds of millions of dollars -- could mean the difference between vitality and sluggishness. 1f1

And for another, we would prefer to avoid investing our research, product development, or organizational-change resources toward ends that won't be interoperably compatible within that future, radically different paradigm. 1f2

INTEROPERABILITY IN AN INDIVIDUAL'S KNOWLEDGE WORKSHOP 2

To begin with some very basic knowledge-domain interoperability issues, consider your own (future?) "Computer-Supported Personal Work" (CSPW). Assume that you have acquired a fairly comprehensive, online "knowledge workshop," you have found better and better software packages to support the kinds of tasks shown in Figure 1: 2a

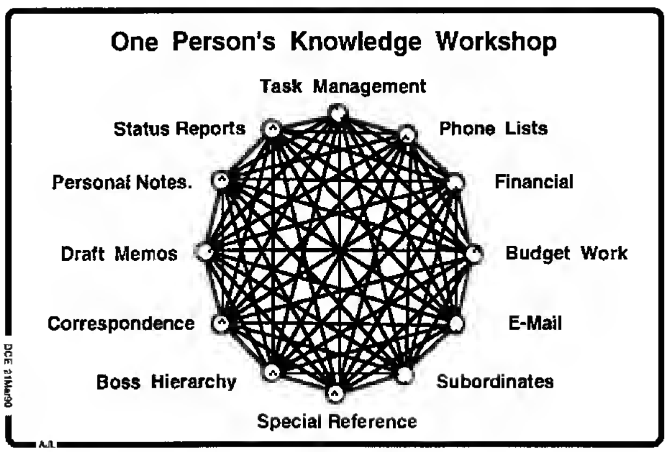

Figure 1. Each functional domain is a candidate for working interchange with all others. 2a1

Consider what you will some day have when your individual workshop inevitably becomes truly integrated. Between the E-Mail and the task management files, or the status reports, or whatever, you really would like to tie these functional domains together with a flexible free-flow of information and linkages. 2b

What kind of interoperability do you have now? I happen to think that the interoperability provided today within most CSPW domains has a great deal of improvement yet to be pursued. But I'd resist any serious arguments about this unless it be approached within the context of a coherent "CSCW interoperability framework" such as outlined below. Let me say in warning, though, that from such a framework I will contend that the marketplace for CSPW will change drastically as CSCW takes hold within our larger organizations and their inter-organizational communities. 2c

INTEROPERABILITY IN A GROUP'S KNOWLEDGE WORKSHOP 3

Suppose that you and a colleague each have a fully integrated CSPW domain, comprised of nicely interoperable sub-domains as in Figure 1. And suppose that you want to work together online. Consider the interoperability between your respective knowledge-work domains, as in Figure 2. 3a

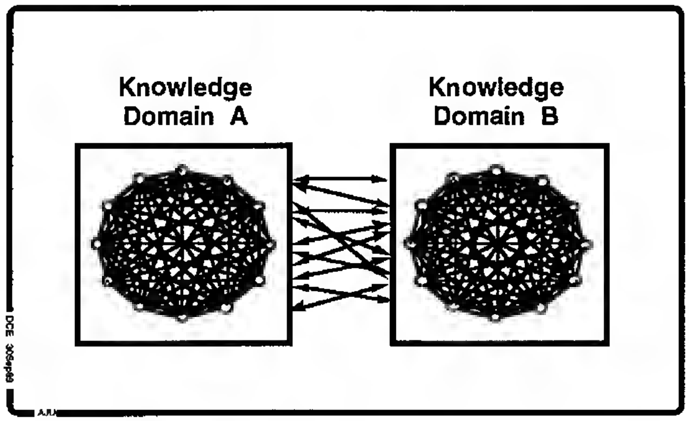

Figure 2. Close cooperation between compound knowledge domains puts new demands on knowledge-work interchange. 3a1

Now you're faced with a new challenge and a new problem. You might set it up so you have a few lines that cross between domains, but why stop there? When do two people in intense cooperative work NOT need total interoperability? In fact they depend on it heavily in the paper world. Why not online? 3b

INTEROPERABILITY ACROSS TIME AND SPACE 4

Yet another example of multiple domains is found in the familiar time-place matrix shown in Figure 3. In many cases, activities in the different quadrants involve the same substantive work content. Is knowledge-work interoperability between the quadrant domains an issue? Very much so. For example, face-to-face meetings need to flexibly utilize anything from the whole organizational knowledge base, and the meeting's records should immediately become an integral part of that same base for later-time work. 4a

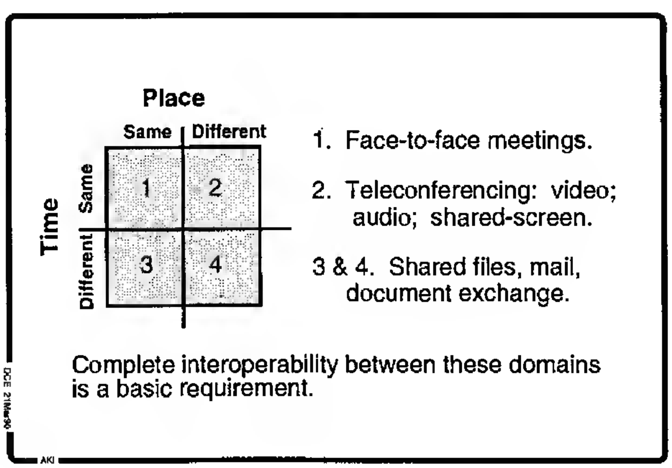

Figure 3. Collaborative processes generally considered 4a1

A Point About Online Group Knowledge Work 5

The matrix in Figure 3 is very neat and ordered. Here in Figure 4 I offer another picture of multi-domain, group knowledge work which isn't so cleanly laid-out. This reflects how I feel about the various knowledge-work domains with which my CSPW domain must interoperate. 5a

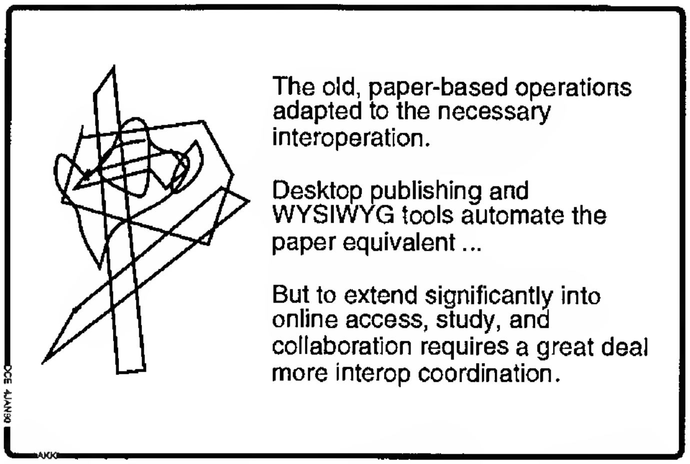

Figure 4. Consider some knowledge domains with which you intersect significantly. 5a1

The purpose of interoperability is to avoid having information islands between which information cannot flow effectively. Since we grew up in a paper-based framework, we've given little thought about how much exchange and interoperability support we really do have, and how much we depend upon it. To be interoperable in our CSPW world we could simply print out and hand over the hard copy. With WYSIWYG screens and Desktop Publishing, we're doing that with nicer paper, faster. 5b

So when we inevitably move from computer-supported paper generation and exchange to computer-supported online creation and exchange, we will need the same level of interoperability. And as the number and scale of knowledge domains involved in a given CSCW "web" increases, so does the need for "online interoperability." 5c

INTEROPERABILITY ACROSS KNOWLEDGE DOMAINS 6

To appreciate the extraordinary complexity of heavy industrial knowledge work, and the associated requirements for interoperability, consider the important functional domains within a large manufacturing organization producing a complex product, such as an airplane. It is a serious enough challenge to provide effective interoperability among the knowledge workers within any one of the domains in Figure 5; just consider the inter-domain challenge. And then consider that some of these domains, such as customers and suppliers, exist "outside" the organization, each with its own equally complex multi-domain structure. 6a

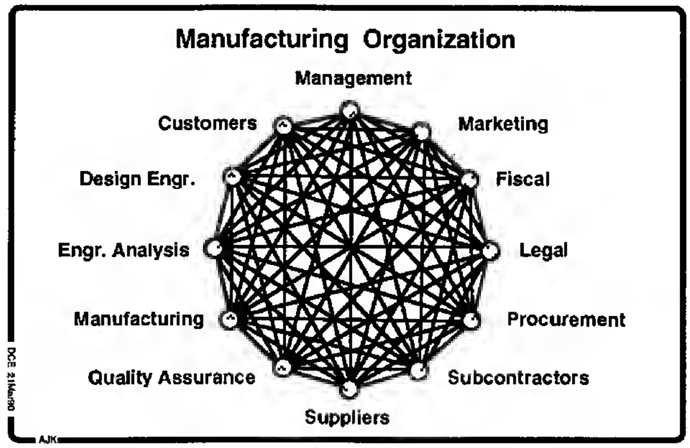

Figure 5. Each functional domain is a candidate for working interchange with all others.

THE LARGE MATRIX ORGANIZATION 7

An interesting example comes from my time at McDonnell Douglas Corporation, where I marvelled at how something as complex as one of their airplanes gets a business plan, and gets designed, manufactured, flown, and supported. Look at any given project or program ("P1" through "Pn" in Figure 6), and the functional support that's required ("F1" through "Fn"), and the exchange that needs to happen within this matrix. 7a

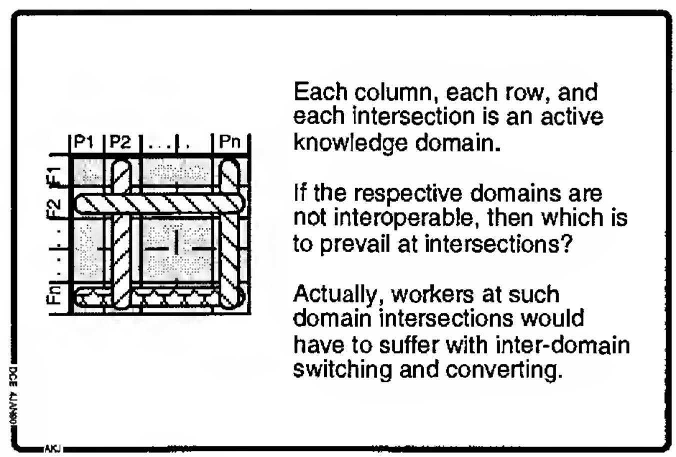

Figure 6. Consider the domains within a matrix organization of projects and function. 7a1

Each function has to share and exchange working information with many programs, and each program has to share and exchange with many functional support areas. Wherever there isn't mutual interoperability, the workers at the domain intersections will have to suffer with inter-domain switching and converting -- which is very expensive. Depending upon this kind of functional program matrix environment will require knowledge-domain interoperability across the whole organization. 7b

THE AEROSPACE INDUSTRY AS A CASE IN POINT 8

To really appreciate the magnitude of this situation, let's look inside one of those aerospace programs. 8a

A Large Aerospace Program. McDonnell Aircraft Company is participating in a bid to build the Advanced Tactical Fighter ("ATF") for the Air Force. It's possibly one of the most technically complex products anyone has ever dealt with. 8b

On top of that, they have an urgent mandate to start practicing "concurrent engineering," where the designers have to work concurrently with the manufacturing engineers. This will require intense back-and-forth cooperation between the two knowledge domains, which no one really knows yet how to do on such a large scale. 8c

Also, significant design and manufacturing problems are often delegated to the first-tier suppliers shown in Figure 7, so the cooperation with that tier is also close and intense. Then the first tiers hand off to the second tiers, and so on. So, all-in-all, you have something like 6,000 companies cooperating -- each a separate, complex, knowledge-work domain. They are expected to keep track of all business- and technical-exchange records throughout the design and manufacturing process: 8d

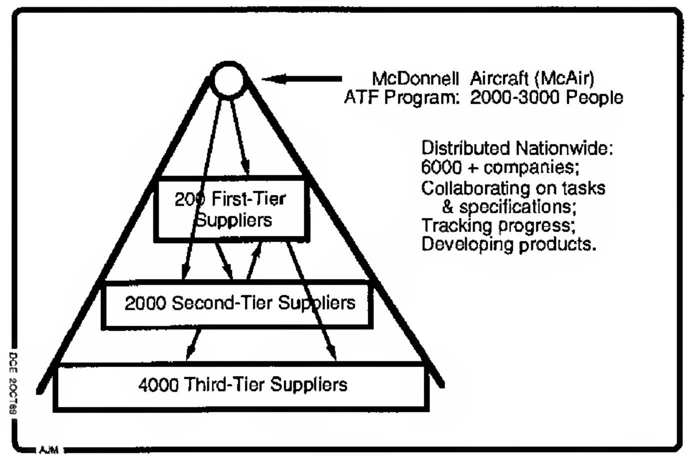

Figure 7. Islands in supplier hierarchy of a major aircraft program would be very costly. 8d1

I should point out here that the arrows in the diagram represent the legal flow of contracts being awarded. The actual exchange of documents would be shown as a two-way flow of continual negotiation and refinement throughout the design and manufacturing process -- developing the specifications, proposals, change orders, testing records, and so on. And for any part within any airplane, the manufacturer must later be able to identify when it was delivered, by whom, and even who was the shop foreman at the time of assembly. 8e

Also, a program of this size in the aerospace world would typically comprise a 10 to 30 year life cycle. So when we talk of Different Time / Same Place, and Different Time / Different Place (Figure 3), the definition of "Time" includes decades, not just hours or days. Even in a short time span and without turnover, it is not unheard of for a project team, in any industry, to occasionally lose sight of some important design decision trails, and consequently waste time and money repeating old discussions or past mistakes. Consider the likelihood, and the cost, of such lost history occurring in this long-term environment. 8f

To comply with the Department of Defense's (DoD's) forthcoming Computer-aided Acquisition and Logistic Support (CALS) mandate, all documents exchanged between the DoD and its contractors must be transmitted, updated, and managed in a standard, computerized form -- a truly gigantic interoperability challenge. 8g

Two Companies' Teaming. The situation is even more complex: as with most new, large-system, DoD procurements, the Air Force requires ATF bidders to be joint-venture teams comprised of major aerospace firms. In this case, McDonnell Aircraft is teaming with Northrop Aircraft. Figure 8 shows how Northrop would form its part of the program, with several thousand workers internally, in close collaboration with several tiers of suppliers: 8h

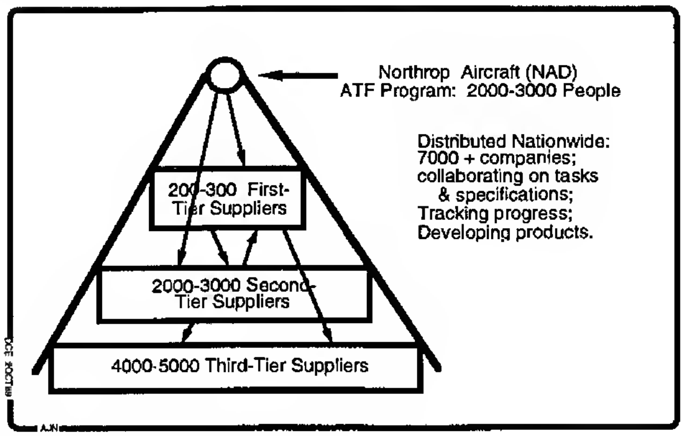

Figure 8. Islands in supplier hierarchy of a major aircraft program would be very costly. 8h1

And then picture the two companies as a team (Figure 9), and consider the intense demands for interoperable recorded document exchange across functional support and project domains within this ATF-contractor team -- within each company, between the two companies, and between them and the DoD (remembering the CALS initiative). 8i

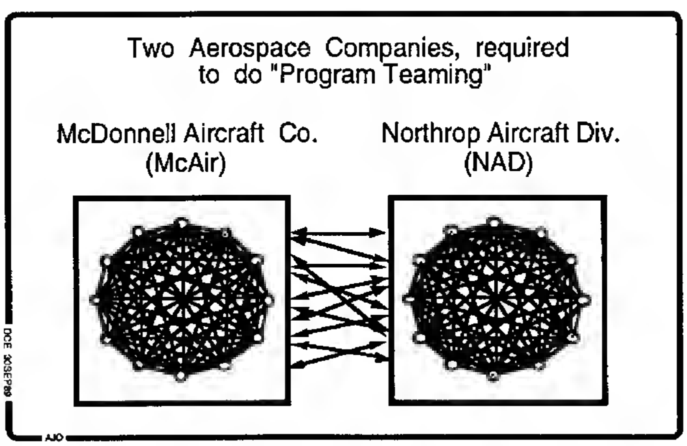

Figure 9. Close cooperation between large organizations puts new demands on knowledge-work interchange. 8i1

And then consider Figure 10 and all of the recorded interchange between these two companies and their supplier hierarchies, throughout the multi-decade life cycle of the program. 8j

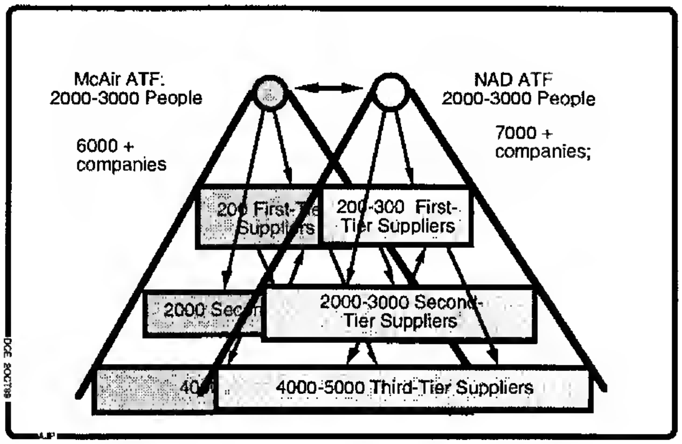

Figure 10. Teamed aerospace program -- immense demand for knowledge-work exchange. 8j1

The Web Of Aerospace Relationships. Now consider all the other large-program webs of aerospace contractors, suppliers, and customers represented by the small sub-set shown in Figure 11. A great many of these suppliers and customers will work with many of the same contractors. The complexity becomes staggering. Within such an inter-knit web of cooperative knowledge domains, there is no practical solution for effective interoperability other than industry-wide standards -- adhered to by contractors, customers, and suppliers. 8k

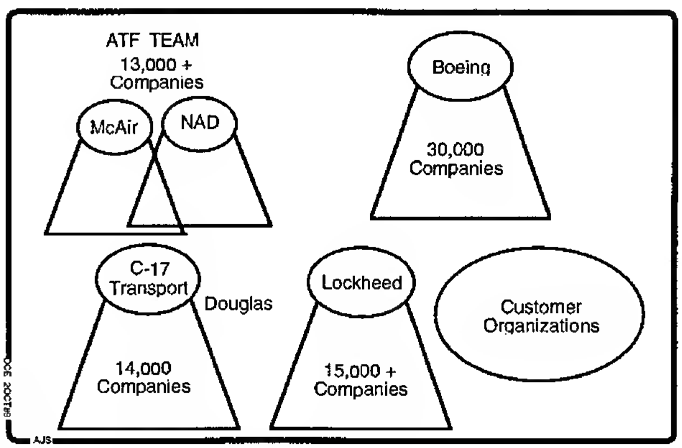

Figure 11. With common customers and suppliers, an aero-space industry can't afford islands. 8k1

And every other large industrial sector must also achieve CSCW interoperability. And those sectors must themselves interact effectively. The CSCW-interoperable web will cover the world, as has clearly been or will be done for transportation and communications (e.g. telegraph, telephone, radio, or TV). I think a strong case can be made that the cost of NOT having total knowledge-domain interoperability would far exceed the cost of achieving this interoperability. 8l

So how will this urgent need be satisfied -- for intense, computer-supported cooperation across the knowledge domains of our rapidly approaching future world? It would seem that our "CSCW future" must include something like the solution characterized below as "an open hyperdocument system." And if so, then all of our research, product development and application exploration should align with and properly affect the concepts and principles by which the future state is pursued. 8m

Towards An Open Hyperdocument System 9

Several years ago at McDonnell Douglas Corporation we coined the term "Open Hyperdocument System" (OHS) and began to define the associated functional and interoperability requirements for the kind of wide-area online cooperative knowledge work described above. This followed several years of careful study, and some pilot trials -- one of which involved thousands of knowledge-workers using a prototype system containing many of the required capabilities. 9a

Note: McDonnell Douglas is poised to move forward with requirements such as below as the basis for functional specifications and a workable procurement process. 9a1

In the following, I assume a need to provide basic capabilities so generic as to satisfy both the CSPW and CSCW application requirements over a broad spectrum of knowledge domains within a wide variety of organizations -- including for instance universities, standards groups, and the U.S. Congress. 9b

SOME GENERAL ASSUMPTIONS 10

In an open hyperdocument system, basic standards for document architecture are of course important. But beyond that, facilities for creating, transporting, storing, accessing and manipulating the hyperdocuments are embedded within an open, interoperable information-system environment, and the combined functionality is available within the knowledge-work domains of every class of worker (working from any vendor's terminal/ workstation of suitable capability). Under these conditions, the role and value of hyperdocuments within groups, and between groups, offers very significant improvements in productive knowledge work. 10a

Two unique issues differentiate this new environment from document-support systems to date: (1) interlinkage between objects arbitrarily located within a large, multi-topic and extended-history document & data collection; and (2) extensive, concurrent, online utilization for creating, studying, organizing and linking within and between the many overlapping and nested knowledge domains. 10b

These differences introduce paradigm shifts that produce different system requirements from those that have been evolving in the predominantly CSPW marketplace. For instance, WYSIWYG will give way to WYSIWYN -- "what you see is what you need (at the moment)" -- providing different options for how you'd view selected portions of the document space in your windows. The WYSIWYG view would be but one option (and likely to be utilized with decreasing frequency). Other expected shifts are implicit in some of the following suggested OHS requirements. 10c

Besides special, "document-system architecture" features, full achievement of large-domain CSCW gains awaits two things: 10d

(1) widespread implementation of integrated, open-system architectures; and 10d1

(2) widespread adoption of new knowledge-work processes (or, "knowledge processes"). 10d2

To me, these new knowledge processes are especially relevant. They will involve new systems of skills, conventions, roles, procedures, methods and even organizational structures. I believe that they will provide a much more effective

matching of basic human capabilities to the heavy knowledge-work and collaborative tasks within the functional human groupings that we call "organizations," and within the mission-specific groupings that we call "projects." 10e

In my experience, truly effective new knowledge processes will emerge only via a co-evolutionary process -- new knowledge processes and the new tools evolving together in real working environments. Explicit evolutionary pursuit with numerous, well-run pilot groups, seems called for. 10e1

From this is derived the position that a really good set of requirements and functional specifications for an OHS can only emerge from solid prototypical experience, in which advanced knowledge processes were developed and exercised along with advanced tools. 10e2

Note that the following list was derived from extensive experience with the evolution of the AUGMENT System (an OHS prototype owned by McDonnell Douglas) and its concurrent application within numerous real-work pilots. 10e3

ESSENTIAL ELEMENTS OF AN OHS 11

Mixed Object Documents -- to provide for an arbitrary mix of text, diagrams, equations, tables, raster-scan images (single frames, or even live video), spread sheets, recorded sound, etc -- all bundled within a common "envelope" to be stored, transmitted, read (played) and printed as a coherent entity called a "document." 11a

Explicitly Structured Documents -- where the objects comprising a document are arranged in an explicit hierarchical structure, and compound-object substructures may be explicitly addressed for access or manipulation of the structural relationships. 11b

View Control of Objects' Form, Sequence, and Content -- where a structured, mixed-object document may be displayed in a window according to a flexible choice of viewing options -- especially by selective level clipping (outline for viewing), but also by filtering on content, by truncation or some algorithmic view that provides a more useful view of structure and/or object content (including new sequences or groupings of objects that actually reside in other documents). Editing on structure or object content from such special views would be allowed whenever appropriate. 11c

The Basic "Hyperdocument" -- where embedded objects called "links" can point to any arbitrary object within the document, or within another document in a specified domain of documents -- and the link can be actuated by a user or an automatic process to "go see what is at the other end," or "bring the other-end object to this location," or "execute the process identified at the other end." (These executable processes may control peripheral devices such as CD ROM, video-disk players, etc.) 11d

Hyperdocument "Back-Link" Capability -- when reading a hyperdocument online, a worker can utilize information about links from other objects within this or other hyperdocuments that point to this hyperdocument -- or to designated objects or passages of interest in this hyperdocument. 11e

The Hyperdocument "Library System" -- where hyperdocuments can be submitted to a library-like service that catalogs them and guarantees access when referenced by its catalog number, or "jumped to" with an appropriate link. Links within newly

submitted hyperdocuments can cite any passages within any of the prior documents, and the back-link service lets the online reader of a document detect and "go examine" any passage of a subsequent document that has a link citing that passage. 11f

Hyperdocument Mail -- where an integrated, general-purpose mail service enables a hyperdocument of any size to be mailed. Any embedded links are also faithfully transmitted -- and any recipient can then follow those links to their designated targets in other mail items, in common-access files, or in "library" items. 11g

Personal Signature Encryption -- where a user can affix his personal signature to a document, or a specified segment within the document, using a private signature key. Users can verify that the signature is authentic and that no bit of the signed document or document segment has been altered since it was signed. 11h

Access Control -- Hyperdocuments in personal, group, and library files can have access restrictions down to the object level. 11i

Link Addresses That Are Readable and Interpretable by Humans -- one of the "viewing options" for displaying/printing a link object should provide a human-readable description of the "address path" leading to the cited object; AND, that the human must be able to read the path description, interpret it, and follow it (find the destination "by hand" so to speak). 11j

Every Object Addressable -- in principle, every object that someone might validly want/need to cite should have an unambiguous address (capable of being portrayed in a manner as to be human readable and interpretable). (E.g., not acceptable to be unable to link to an object within a "frame" or "card.") 11k

Hard-Copy Print Options to Show Addresses of Objects and Address Specification of Links -- so that, besides online workers being able to follow a link-citation path (manually, or via an automatic link jump), people working with associated hard copy can read and interpret the link-citation, and follow the indicated path to the cited object in the designated hard-copy document. 11l

Also, suppose that a hard-copy worker wants to have a link to a given object established in the online file. By visual inspection of the hard copy, he should be able to determine a valid address path to that object and for instance hand-write an appropriate link specification for later online entry, or dictate it over a phone to a colleague. 11l1

HYPERDOCUMENTS IN A GENERAL INTEGRATED ARCHITECTURE 12

Besides the aforementioned Hyperdocument Mail and Hyperdocument Library features, there are other important CSCW features that are dependent upon an "integrated system". 12a

Shared-Window Teleconferencing -- where remote distributed workers can each execute a related support service that provides the "viewing" workers with a complete dynamic image of the "showing" worker's window(s). Used in conjunction with a phone call (or conference call), the parties can work as if they are sitting side-by-side, to review, draft, or modify a document, provide coaching or consulting, and so on. Control of the application program (residing in the "showing" worker's environment) can be passed around freely among the participants. 12b

Inter-Linkage Between Hyperdocuments and Other Data Systems -- for instance, a CAD system's data base can have links from annotations/comments associated with a design object that point to relevant specifications, requirements, arguments, etc. of relevance in a hyperdocument data base -- and the back-link service would show hyperdocument readers which passages were cited from the CAD data base (or specified parts thereof). 12c

Similarly, links in the hyperdocuments may point to objects within the CAD bases. And, during later study of some object within the CAD model, the back-link service could inform the CAD worker as to which hyperdocument passages cited that object. 12c1

External-Document Control (XDOC) -- Same "catalog system" as for hyperdocument libraries -- with back-link service to indicate links from hyperdocument (and other) data bases, for any relevant material that resides offline or otherwise external to the OHS. 12d

THE INTEROPERABLE OHS ENVIRONMENT 13

Here's what the share-and-exchange domain within an open hyperdocument system might look like: 13a

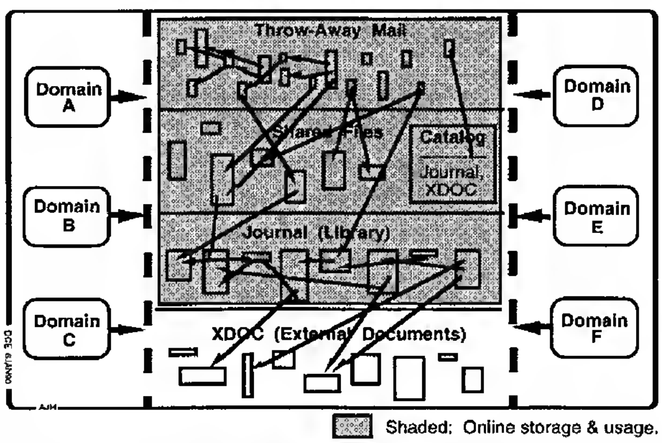

Figure 12. Knowledge-domain interoperability is greatly enhanced by hypertext linkage capability. 13a1

The requirements outlined above form a basic support platform for any group knowledge work effort, with interoperability across time and space (including all quadrants of the Time / Place matrix), across knowledge domains, and across organizational domains. 13b

THE INTEROPERABILITY INVESTMENT 14

It could take a lot of effort and expense to get such knowledge-work interoperability. You might say, "Why don't I just do the part that's important?", as in Figure 13, Choice A. Someone else's idea of what's important to share and exchange may look like Choice B: 14a

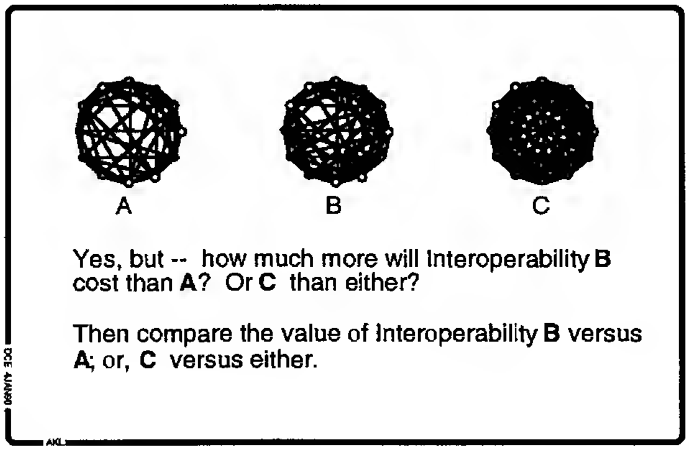

Figure 13. Providing for extensive interoperability will be expensive. 14a1

As more and more of the knowledge work in each domain is done online, then the benefits of a comprehensive degree of CSCW interoperability will rapidly increase. 14b

How do you decide how far to go? You'd compare the value of A vs. B, or B vs. C. And you'd say, "Well, let's see, with each successive choice I'd save more money, wouldn't I?" So how much more? We don't know how to quantify it yet. But, once you start finding a way to make some of the major sub-domains interoperable, by the time you've picked these selective lines in Choice A or B, what would be the incremental cost in dollars and effort to get Choice C? 14c

But the real question is, what does it cost in dollars and effort NOT to have the interoperability. 14d

THE OHS MOVEMENT 15

I asked people familiar with complex aerospace projects, "Well all right, let's make a guess -- if the kind of hyperdocument interoperability we are talking about here were installed for instance under the whole design & manufacturing operation of this ATF program, what might the yearly dollar benefit be?" They look back and forth at each other for a while ... So I offer: "$300,000,000 a year?" And they look at it and say, "At least." 15a

User organizations must realize that they can't just sit back and wait for the standards groups and computer vendors to deliver this, because there hasn't yet been enough orientation or application experience in this area. It seems necessary for the larger user organizations to take responsibility, to become pro-active -- e.g., with exploratory pilots, active development of associated knowledge processes, and cooperative requirements definition -- and then show the vendors that there is a sizable market for this. 15b

But they must also realize that it isn't just a matter of specifying, procuring, and installing the resulting system -- they have to learn how to employ it effectively in this extremely complex environment. And they must realize that they have to cooperate more intensively than before: The stakes are extremely large; there is too much to learn and events are moving too rapidly; the resources and degree of stakeholder coordination involved are both very high. 15c

To find this effort emerging from within the aerospace industry seems likely enough to me: it is the most complex work environment I know of, and a most urgent candidate for harnessing the benefits of wide-area CSCW and effective knowledge-domain interoperability. But other large organizations also have pressing needs for exactly this same capability -- for example, car manufacturers, computer vendors, government agencies, consulting firms, universities, consortia, and standards groups. 15d

To me there is a real need for a cooperative movement -- among large organizations that are heavily dependent on group knowledge work -- to coordinate planning and operation of advanced, cost-effective pilot explorations in this area and to share the experiences and results. This relates to what I am currently doing at Stanford University with the Bootstrap Project: exploring with a number of larger organizations how a "cooperative, CSCW community" could be set up and run to provide both valuable pilot-application experience and substantive knowledge products. 15e

One of the first projects of this community would be to collaborate on the requirements for an open hyperdocument system, and on a procurement approach. The community would employ a prototype OHS platform (initially AUGMENT from McDonnell Douglas) to collaborate on this and other related projects. This hands-on experience will be an important part of the exercise, and should provide valuable insight into how to employ these capabilities effectively. Similar pilot trials will be launched within member organizations. 15f

ACKNOWLEDGEMENTS: 16

This work was sponsored by grants from the Kapor Family Foundation, Sun Microsystems, Inc., and Apple Computer, Inc. 16a

For more background on the source experience from which these proposed OHS requirements grew: 17

Engelbart, Douglas C., "Toward High-Performance Knowledge Workers," OAC '82 Digest, P*rocedings of the AFIPS Office Automation Conference*, San Francisco, April 5-7, 1982, p. 279-290 (AUGMENT,81010,). Re-published in "Computer Supported Cooperative Work: A Book of Readings," ed. Irene Greif, Morgan Kaufmann Publishers, Inc., San Mateo, CA, 1988, pp 67-78. 17a

Engelbart, Douglas C., "Authorship Provisions in AUGMENT," COMPCON '84 Digest, *Procedings of the 1984 COMPCON Conference*, San Francisco, CA, Feb 27-Mar 1, pp. 465-472 (OAD,2250,). Re-published in "Computer Supported Cooperative Work: A Book of Readings," ed. Irene Greif, Morgan Kaufmann Publishers, Inc., San Mateo, CA, 1988, pp 67-78. 17b

Engelbart, Douglas C., and Lehtman, Harvey G., "Working Together," BYTE Magazine, December 1988, pp. 245-252. 17c

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Office Computing
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Paradigm Shift

Guide to the Information Revolution

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Doug Engelbart's Design for Knowledge-Based Organizations—Part 1

Required Technology: Open Hyperdocument Systems

IN BRIEF: Doug Engelbart is the seminal visionary in the field of computer-supported collaborative work. For over 40 years, he has been actively involved in the design, prototyping, and implementation of systems to support collaborative knowledge work. This two-part issue is Engelbart's call to action. He wants us to build on his experience to speed the evolution of our organizations' information systems into true collaborative knowledge-refining organisms.

In this first issue, we examine the technology design principles that, according to Engelbart, need to be incorporated in the evolution of open, standards-based information systems in order to support collaborative knowledge work optimally across computer systems and within and across organizations.

P.S.

This month's audiotape contains an interview with Doug Engelbart—next month look for more of my discussions with Doug on videotape.

Doug Englebart's Design for Knowledge-Based Organizations—Part 1

Required Technology: Open Hyperdocument Systems

Patricia B. Seybold
President,
The Office Computing Group

Enduring Value: Knowledge Creation and Dissemination

Understanding the Knowledge-Value Equation

In 1985, Japanese futurist Taichi Sakaiya published *The Knowledge-Value Revolution (Chika Kakumei),* a book that quickly became a best-seller in his country. It was translated and published in America in 1991. One of Sakaiya's contentions is that the knowledge portion of all goods and services will be the most highly valued by consumers. His basic premise is that human society, by nature, gravitates to the consumption of those resources that are most abundant. And, in the coming decades, knowledge and time will be our most abundant resources. Our economic systems, our social systems, and our businesses are already in the process of evolving into their new "knowledge-value" forms. But only those individuals and organizations that can capitalize on capturing, leveraging, and incrementing the knowledge portion of their goods and services will be the survivors in the new economic order—a world in which mass-produced, identical goods will have given way to goods custom-produced by entrepreneurial, information age, knowledge workers.

Collaborative Knowledge Work: Key to Coping with Increasing Complexity & Urgency

Doug Engelbart came to similar conclusions about the value of knowledge 40 years ago when he began to speculate about the impact of two converging trends he witnessed in the world around him: increasing complexity and increasing urgency. He correctly presumed that humans would not be able to deal with the spiraling effects of these two inexorable demands on business and society. Since his academic training was that of an electronics engineer, he turned to electronics to find some antidote for the ills he knew were about to beset modern society. Engelbart realized that the key to dealing with increasing complexity was human collaboration. Many human minds with different perspectives, different specialties, and different experience bases working together and sharing their knowledge, perspectives, and experience would be able to master complex tasks that no single human would be able to master.

P.S.

The Knowledge-Value Revolution by Taichi Sakaiya, was published by Kodansha International in 1991. (Distributor: Kodansha America, Inc. NY) ISBN (U.S.): 0-87011-942-7.

3

Douglas C. Englebart, Director, Bootstrap Institute

Capturing Knowledge within and across Organizations

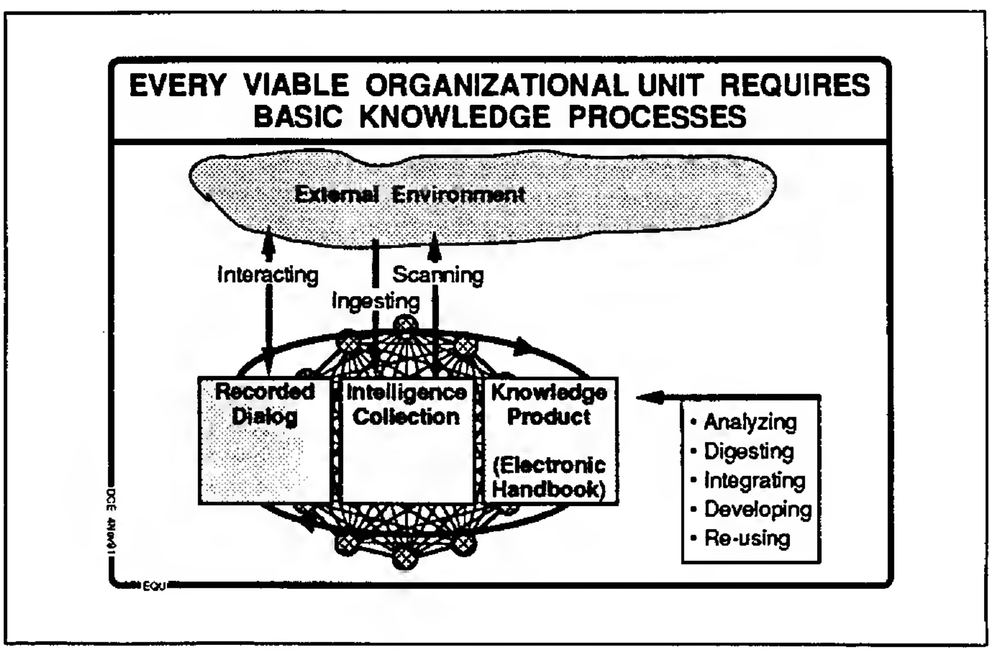
An Organization Is Composed of Multiple Knowledge Domains

Engelbart sees every organization as a collection of interacting knowledge domains. He has focused his research on designing support structures for knowledge collection and refinement within and across these knowledge domains.

Understanding the Basic Knowledge Process

According to Engelbart, each knowledge domain or organizational node uses the same basic process to assimilate, analyze, integrate, digest, and re-use the knowledge products it creates. Once we understand that process, we can support and enhance it with computers, communications, and software. Here is how Engelbart depicts this basic knowledge process:

How Any Organizational Unit Processes Knowledge



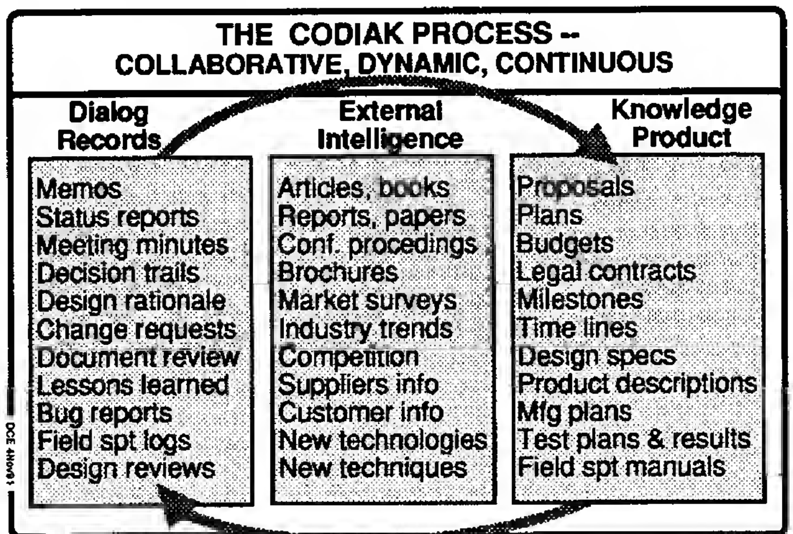
The basic knowledge processes of each viable organizational unit. The organism scans its external environment for new information and ingests that information. At the same time, the organizational unit is interacting with the rest of the world in conversations and dialogue. The members of the unit are working together to produce an evolving knowledge product that consists of the output of their work and everything it took to produce that work.

Capturing Knowledge within and across Organizations

An Exploded View of the Knowledge Collection and Assimilation Process

If we take a closer look at the on-going basic knowledge process, we see that, according to Engelbart, it can be segmented into three distinct types of information, each of which exists in the context of the continuous and dynamic Concurrent Development, Integration, and Application of Knowledge (CODIAK) process.

The CODIAK Process



CODIAK: COncurrent Development, Integration, & Application of Knowledge.

Today's Systems Aren't Set up to Capture Knowledge

Engelbart asserts that the CODIAK process is the way humans acquire and evolve their knowledge in collaboration with others. He notes that we haven't set up our computerized information systems to deal with all three forms of these knowledge-building categories of information in any integrated way. Therefore, we aren't reaping most of the benefits that could be derived from the CODIAK process within a single organizational unit, not to mention the benefits that could be derived by designing architecture to support it across organizational units and across organizations.

Needed: A Common Infrastructure for Collecting and Interrelating All Forms of Knowledge

As you can see from Engelbart's conception of the CODIAK process, he feels that there should be no distinction made between formal and informal documents and between internal and external (to the system or organization) information. The way that any organism (individual, department, or larger entity) builds and modifies its view of the world depends on making interrelationships among all of these different

P.S.

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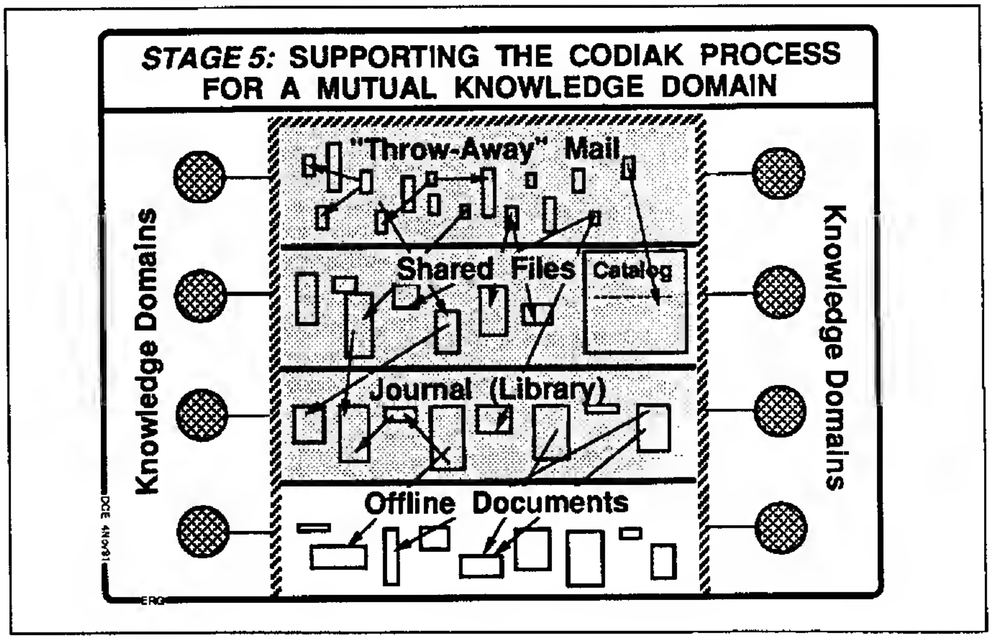
modes and forms of information. It is also essential that information be maintained, to the extent practicable, in context.



The Role of the Journal. In Engelbart's ideal world, everything that people want to build upon and refer to—both the material they create electronically and the material they make reference to in the outside world—should be "journaled." That is, it should be uniquely labelled by the system and preserved so that people can continue to make use of it and reference it. Journaling also enables you to easily keep track of multiple versions of a work in progress or of multiple iterations of a budget. Each one is journaled, the journal knows which one supersedes the others, and usually only the new or changed material really needs to be kept.

How many of you already keep an electronic log or journal of files written and received, electronic mail, and so on? Wouldn't it be nice if your system automatically filed that information for you? Wouldn't it be nice if you could easily add references to external documents, flyers, brochures, customer correspondence, etc? Wouldn't it be nice if others in your organization could have access to that information, so they could refer to it, link to it, etc.? What would you do with your private documents? Probably encrypt them or password protect them so they could be maintained with the rest, but only viewable by you. What about potentially incriminating documents? Internal discussions of a sensitive nature? Would you keep them journaled, or shred them quickly?

Capturing Knowledge within and across Organizations

What Should You Keep? I asked Engelbart about the need to maintain and journal "throw away" electronic mail. His experience showed that it was much easier to consider everything in the system useful and preserve it than to require people to go through the mental exercise of deciding a priori what to preserve.

How the Knowledge Base Organically Prunes Itself. Obviously, every bit of information generated on a system is not going to prove useful or relevant. In fact, only a relatively small portion of it might prove really useful. Therefore, according to Engelbart's design, every time anybody references any material, whether it is a mail message, a graphic, or an official memo, that fact is noted and becomes an attribute of the referenced item. That way, the material that is never referenced by anyone automatically becomes a candidate for routine archiving. A record is maintained of its existence and its archived location enabling you to retrieve it in case the information ever becomes important in retrospect. So you can see that Engelbart's design of an evolving information infrastructure or knowledge base is an organically self-limiting beast.

Designing Systems to Support the Evolutionary Growth of Knowledge

Doug Engelbart is adamant about the fact that, according to his experience, it is not possible to really take advantage of, build on, and evolve an organism's knowledge base unless that information can be both interrelated and structured.

The Importance of Structured Documents. Documents, whether they are memos, CAD/CAM drawings, or database views, already have an inherent structure that is derived from the conceptual model the author had when he created them. The structure of documents is not arbitrary or force-fit, but, rather, derives from the natural organization of the concepts being presented (which, of course, can sometimes be improved upon by reorganizing, or restructuring, the document). Engelbart is not advocating that we perform artificial acts with documents by superimposing structure on them. Instead, he advocates that we capture the inherent structure in all forms of human expression in order to make them easier for people to navigate through, view in different ways, and hyperlink (interlink one point in one document with a point made or illustrated in one or more documents).

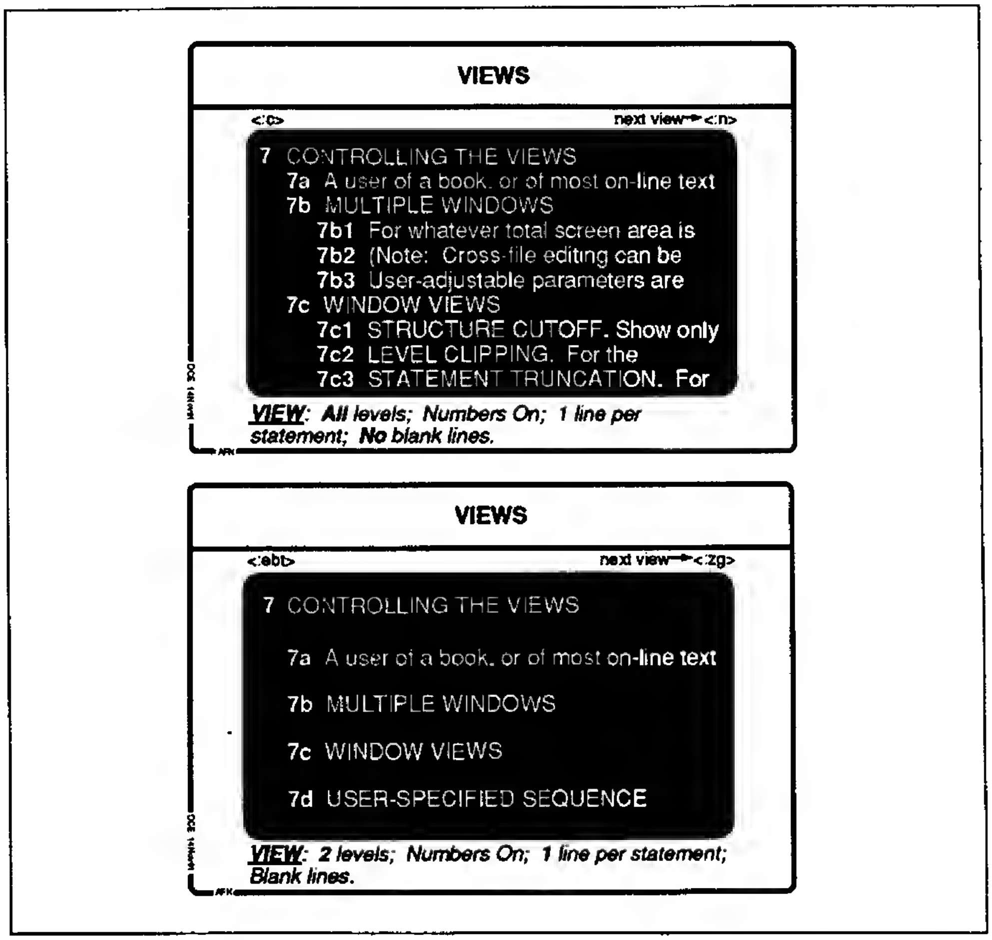
The Importance of Views. Those of you who have worked with a word processor, spreadsheet, or database that understands the notion of collapsing and expanding views, or outlining, have probably grown to appreciate that feature. Engelbart feels it is imperative that, in a truly open and interoperable world, people should be able to have total and very flexible control over how they want to view information. And, since we are not likely to all choose to use the same applications to create our infor-

P.S.

Please pay attention to this discussion. The importance of using—not losing—the structure in our documents, CAD drawings, etc. is finally dawning on most of us as we begin to organize and keep more information electronically. Without structure, information is not really actionable. You can't find what you need quickly, and when you do find it, the actions you can take are limited, once all the structure (and behavioural knowledge) has been removed.

mation, it is also imperative that there be a consistent set of viewing behaviors and navigational conventions in all interoperable applications.

Two Different Views Enabled by Document Structure



Filtering & Navigating with Views. In Engelbart's scheme of things, views aren't used only to condense and expand views of information. You can also create special purpose filters—for instance, everything written by a certain person on a certain topic. In fact, in Engelbart's original system, end users could give instructions to a module known as a sequence generator to create special purpose hypertrails through webs of information.

The importance of the need for flexible Views really came home to me when I visited Clorox recently and looked at the documentation they use for their manufacturing process. Different people in the plant need very different views of information: recipes, safety information, packaging information, shipping information— and yet it's all part of an organically changing whole.

Capturing Knowledge within and across Organizations

The Need for Granularity. As you've probably deduced from the emphasis on preserving structure, inheritance, and hierarchy in documents, and the desirability of using that structure to expand or collapse information so that you can view it, filter it, and navigate through it at different levels of detail, it is also imperative to be able to precisely direct a reader's attention to a very specific point within a document. We agree with Engelbart that it's not sufficient to insert a hyperlink from one document, card, or note file to another. Instead, you really need to be able to link very precisely to a specific phrase, word, or even a single character within a document or file.

The Need for Relative Addressability. It's also important to be able to direct a person or an application to the referenced point. Engelbart explains it this way: "It's like the way the municipal system puts house numbers on houses. You can use it if you wish to tell somebody how to get to a certain house, or send a letter to it. Or you can say, 'If you go to 4th and Main and go west on 4th until you find the second yellow house on the left.' That's another way, relatively speaking. You give an exact address and then something relative to it. Or you can say, 'Hey, someplace on 4th, west of Main, you can find where Joe lives. Go ask for Joe.'"Similarly, if you didn't remember the exact directions to give someone to find something you want him to see in the electronic world, you could direct him to a particular node in the system and then tell him to go down a level, jump to the end, and take the second link he finds there.

The Need for a Common Command Language. As we begin to interconnect our organizations' information systems via networks, electronic mail, interoperating applications, and shared work products, it will become more and more essential that these information systems, applications, and the information itself respond consistently to the commands we use to interact with information and to navigate through it. Doug Engelbart describes the future this way: "Suppose you and I work for two different companies, using two different computer systems and many different applications. One day, you send me an electronic mail message relating to some work that we are doing together. The message contains a link to information in a file that you want me to review. The file is located on your system, and you have granted me read/write permission to this file for the duration of this project. There is only one hitch. When I click on the link and am transported across the network into your information system and the file is opened for me along with the application required to manipulate the information, how do I know what to do? Do the buttons in your application do the same things that I'm used to? How do I know how to navigate through the file/application?"

P.S.

No one else, with the possible exception of Dave Liddle of Metaphor/Patriot/IBM has argued so coherently for a set of cross-system behavioral, navigational and command standards and expectations. If all our systems act differently, not only on the surface, but also deep down—if there is no underlying unifying structure—we'll never achieve the level of interoperability we need to design knowledge-based organizations.

This simple example (simple because only two people and two systems are involved) illustrates the point. If we are to have that kind of interactivity among knowledge workers and across applications and systems, we need to pay more attention to agreeing on a core set of commands, methods, and navigation conventions, that could be implementable across applications. These would need to be extensible, of course, so that special purpose commands and shortcuts could be added. One of the analogies that Engelbart makes to describe this phenomenon is the following; If you were suddenly transported from New York City to a village in the south of France, and you didn't speak French, how would you find your way around? As human beings, we have conventions for these things that cross cultural boundaries—maps, street signs, directional signals, common conventions (such as, in many parts of the world, sidewalks and streets) that people have developed and learned over time. As we work to define standards for open, interoperable systems, we need to take care that we also agree upon and evolve standard conventions for commands, navigation, and expected behavior of certain classes of objects.

What Steps Can We Take to Evolve an Open Hyperdocument Standard?

Needed: User Experience. Engelbart assumes that the future tool-base underlying our highly improved CODIAK capability will be a multi-media, hyperdocument *system*. Engelbart feels that the only way to seriously work towards creating a viable specification for an open hyperdocument architecture is to get real users in real businesses to pool their experiences as they work toward creating improved CODIAK capabilities within their own organizations. Some people will begin to build improved CODIAK capabilities using their existing systems and running into and documenting the roadblocks they encounter. But for much greater evolutionary efficiency, a number of organizations may choose to collaborate on the development of a shared, common, prototype hyperdocument system to support cooperatively planned CODIAK-enhancement pilots in each organization—integrating their collective users' experiences toward evolving an ever more generic and interoperable hyperdocument system. If one or more such collective initiatives got underway, all poooling resources and experiences, they would be able to distill the most important specifications and requirements and begin to work with standards groups and consortia to make these requirements part of the open systems interoperability process.

Start with Engelbart's Paper on the OHS. I recommend that you start by requesting, from the Bootstrap Institute, a copy of the paper, "Knowledge-Domain Interoperability and an Open Hyperdocument System." This paper goes into a bit more detail in delineating the specific requirements that Englebart foresees we'll need.

If you'd like more information about Engelbart's Boostrap Initiative, or, if you'd like to order the article mentioned above, "Knowledge-Domain Interoperability and an Open Hyperdocument System," call (510) 713-3550.

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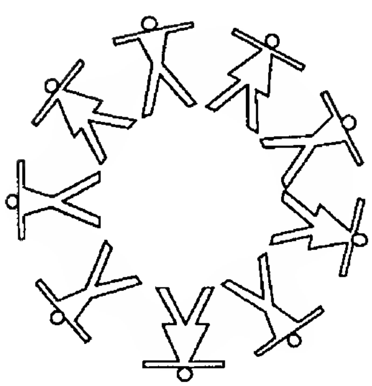

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Paradigm Shift

Guide to the Information Revolution

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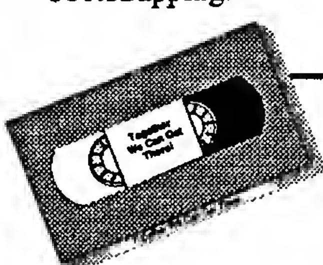
Doug Engelbart's Design for Knowledge-Based Organizations—Part 2

Co-Evolution of Organizations & Technology

IN BRIEF: This two-part issue is Doug Engelbart's call to action. He wants us to build on his experience to speed the evolution of our organizations' information systems into true collaborative knowledge-refining organisms.

In the second of this two-part series (which is designed to complement the audio- and videotaped interview with Doug Engelbart), we look at the interactions among people, organizations, cultural and business practices, and technology. We all know from experience that these are inextricably intertwined. Doug Engelbart offers a blueprint for the transformation of today's organizational structures into true collaborative, knowledge-based organizations. What may surprise you about this blueprint is that Engelbart has found, through experience, that the best leverage point in the human/technology/organization/process system is to focus not on improving the organization's core business, but on improving the improvement capability of the organization.What Engelbart calls "bootstrapping."

P.S.



This is the second of a two-part series designed to accompany both the audiotaped and videotaped versions of an interview with Douglas C. Engelbart. The Video is entitled: "Together We Can Get There!"

Doug Englebart's Design for Knowledge-Based Organizations—Part 2

Co-Evolution of Organizations & Technology

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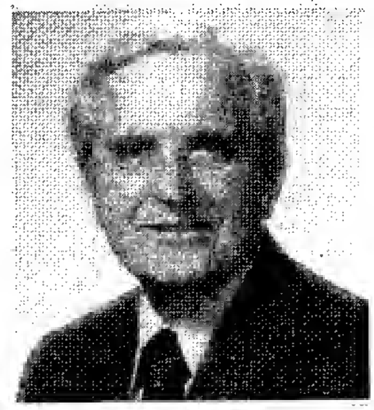


Today's Organizations Are in Danger of Extinction

Needed: Improved Organizational Nervous Systems

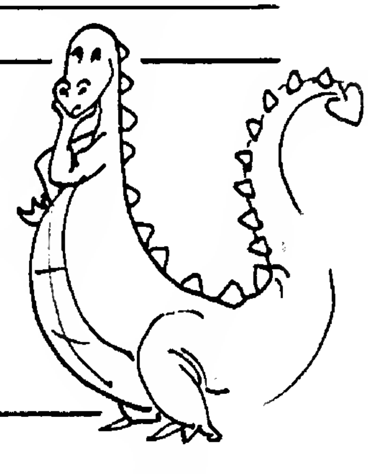
Doug Engelbart likes to compare human organizations to living organisms; both evolve in response to the world around them. He says that, like living, biological creatures, organizations mutate, and those mutations are continually being tested for survival value within their environment. Engelbart feels that "today's environment is beginning to threaten today's organizations—finding them seriously deficient in their nervous system design—and that the degree of coordination, perception, rational adaptation, etc., which will appear in the next generation of human organizations will drive our present organizational forms, with their clumsy nervous systems, into extinction."[1]

Teaching Organizations to Learn

Since the late '50s, Engelbart has been hard at work on the redesign of organizational nervous systems. By 1970, he was deeply involved in what he dubbed his "Human Intellect Augmentation" project. He explained: "By intellect, I mean the human competence to make, send, exchange, and apply to decision-making the commodity called knowledge, as applied toward giving human individuals and organizations more effectiveness at formulating and pursuing their goals."[2] Engelbart could foresee that the nervous systems that organizations had evolved in order to thrive in the industrial age were not going to be adequate to take them into the knowledge age. What was needed was a major advance in organizations' abilities to think, to observe, and to assimilate, apply, and refine knowledge.

1. From the paper "Intellectual Implications of Multi-Access Computer Networks," by Douglas C. Engelbart. Published in April, 1970 —Document # Augment 5255-2e)

2. Ibid, (5255-3)

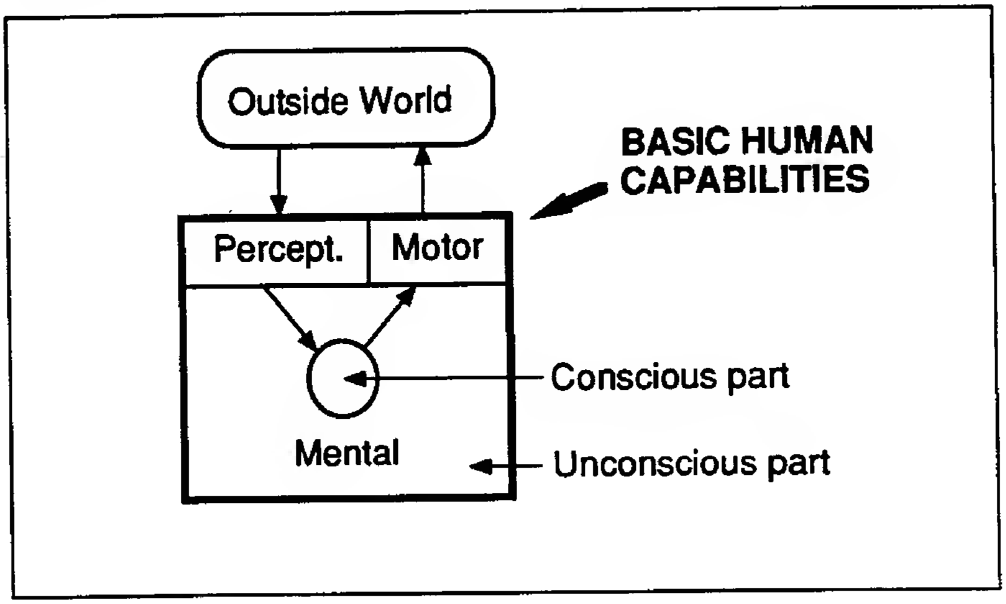


Redesigning Organizations for the Knowledge Age

First: Start with Human Systems

Organizations are composed of humans, so it's appropriate, Englebart reasoned, to begin by looking at the process individuals use to make sense out of the world. "First," Engelbart said, "let's start with the capabilities with which humans are biologically endowed." These include "the human's mental capabilities, such as memory, visualization, learning, and reasoning, and the linkage to the human's internal/external environment by his or her sensory perception and coordinate-motor I/O systems."

Humans Start with a Biologically-Provided Cognitive System



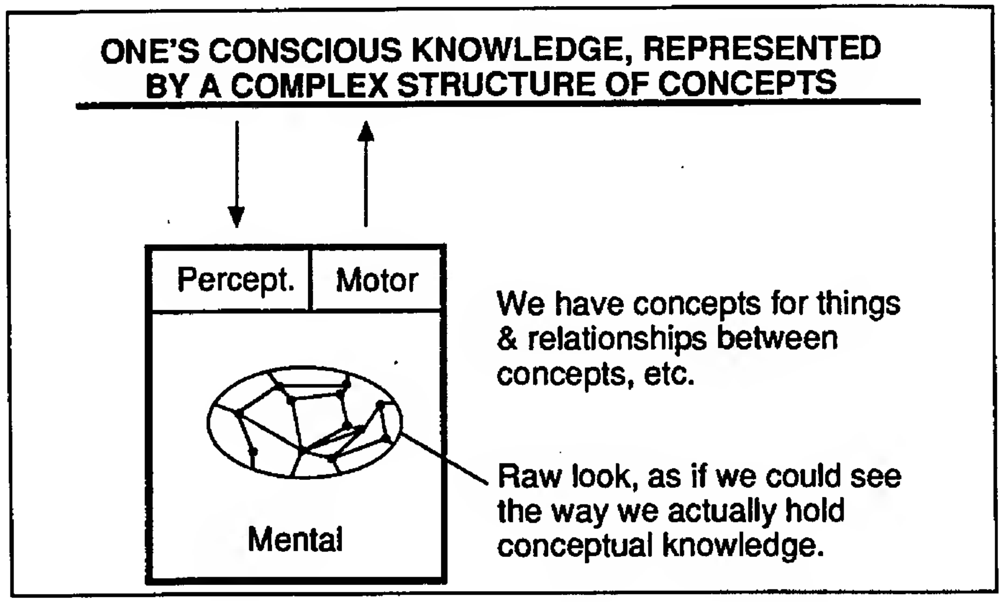
Starting to think about augmenting the knowledge-worker? Begin with the basics.

Basic Biological System Is Embedded in a Cultural System

The culturally provided components of the basic human system are equally important. According to Engelbart, these include, among others, "language, values structure, attitudes, and motivations as well as education, training, methodologies, and tools. These come in specific forms, such as: algebra, schools, meetings, books, computers, maps, and filing cabinets."

Doug points out that the amount of unconscious capability humans have and continue to learn is astounding. Think about how you learn to brush your teeth, tie your shoes, etc. At first, it takes a lot of conscious attention, soon you become unconsciously competent at it. Organizations have many of the same characteristics. There are many things they are unconsciously competent at doing as well as other capabilities which they practice consciously. Obviously, to augment human systems (individuals and organizations), you need to improve both the conscious and the unconscious capabilities.

How Humans Hold & Navigate Conceptual Knowledge



How do we actually "map" concepts in our brains? Doug Englebart points out that we have interconnected webs of conceptual knowledge. The way we store away knowledge, make associations, navigate through those knowledge structures is very different from the way we represent knowledge on pages of paper. He feels that knowledge that is captured and stored electronically should be and can be mapped much more closely to the way humans actually process knowledge in their minds than the way we do it on pieces of paper in books.

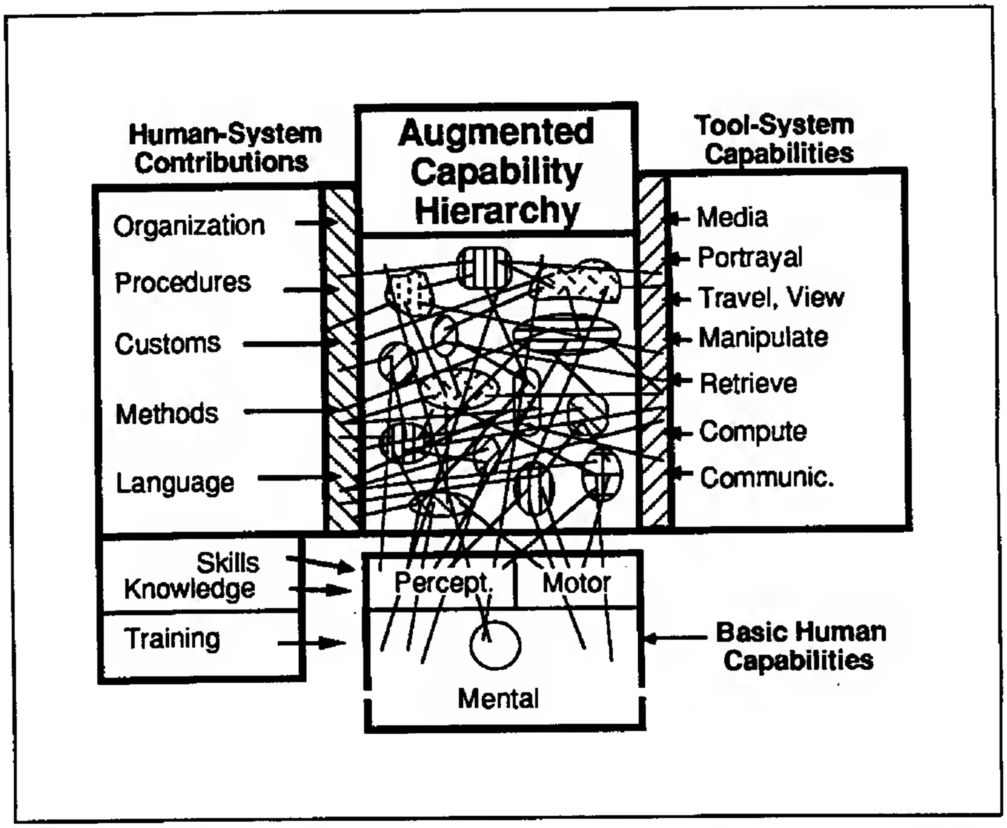
Human Capabilities Build On One Another

It is staggering to think about the extent to which all of our basic human capabilities are interdependent and intertwined. For example, you need the basic capabilities to read and write in order to have the capability to write a memo. You also need the tools to do so (whether these are paper and pencil or a word processor). These capabilities are multi-level. Higher level capabilities depend on the ability to integrate the execution of lower level capabilities into a process which exhibits new higher level capabilities. When you augment basic human capabilities with human and tool systems, that augmentation is pervasive throughout all the multiple levels of definable capabilities. Engelbart points out that the current scope of the change that organizations are experiencing on the tools systems side of the equation throws into question all of the practices on the human systems side.

P.S.

If you think about it, Doug Engelbart's model of hyperlinked chunks of structured information fits the human conceptual map (as we understand it) quite well. On the one hand, Engelbart's original design presumed a hierarchical document structure as the basic starting point, with the ability to make infinite relational links among any of the thought chunks. "Why a hierarchy?" He's often asked. I think it has to do with the way we label and chunk information from short term memory into long term memory–The Information Mapping (TM) notion of grouping 7 (+ or - 2) chunks of information together under one conceptual label and moving on to the next set of concepts.

Basic Human Capabilities Interacting with Human Systems and Tool Systems



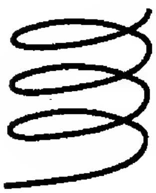
Humans operate within cultural and organizational contexts, using tools that enable them to interact with the world and with one another.These human and tools capabilities combine together in intricate and overlapping ways in order to augment the basic human capabilities.

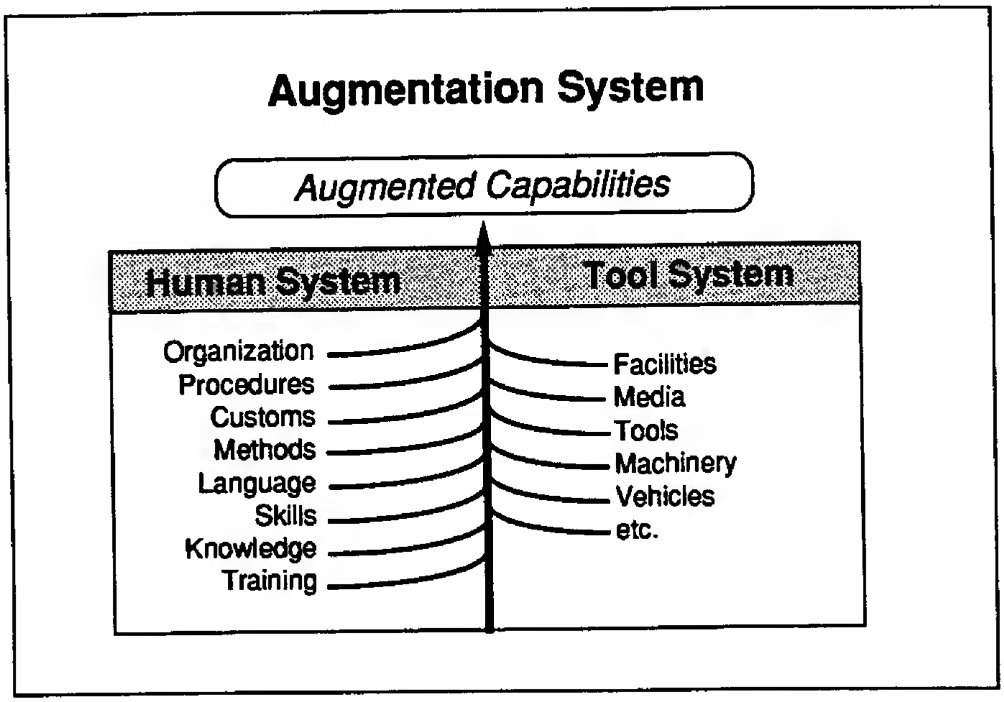
To Augment Human Capabilities, Augment Both Tool and Human Systems

It goes without saying that there's not much we can do to improve the basic, biologically provided capabilities humans are born with, nor do we have much control over the culture within which we are raised. However, organizations can affect their own culture in meaningul ways. and they do have control over both the human systems and the tools they evolve. Therefore, Engelbart points out that companies should assume in their budgeting and planning process that all human and tool systems are candidates for improvement.

The notion of how interdependent our human and tool systems are in organizations really came home to roost at our Executive Forum Workshop held in March. As we worked in teams to solve particular organizations' technology-related problems, we weren't at all surprised that we found ourselves spending a lot of time on organizational issues, like managing change, shifting organizational culture, and redesigning business processes.

Focus on Co-Evolution of Human and Tool Systems





To augment any significant organizational capability, you have to improve both sides of the system.

To augment human knowledge-refining and learning capabilities, we need to co-evolve both the human and tools systems sides of the equation. While most of us realize this instinctively, there are few efforts underway that consistently employ this co-evolution strategy. Engelbart points out that "with the recent computer revolution, many organizations' augmentation systems are now heavily weighted with point-solution technology, seriously overpowering the human-system elements."

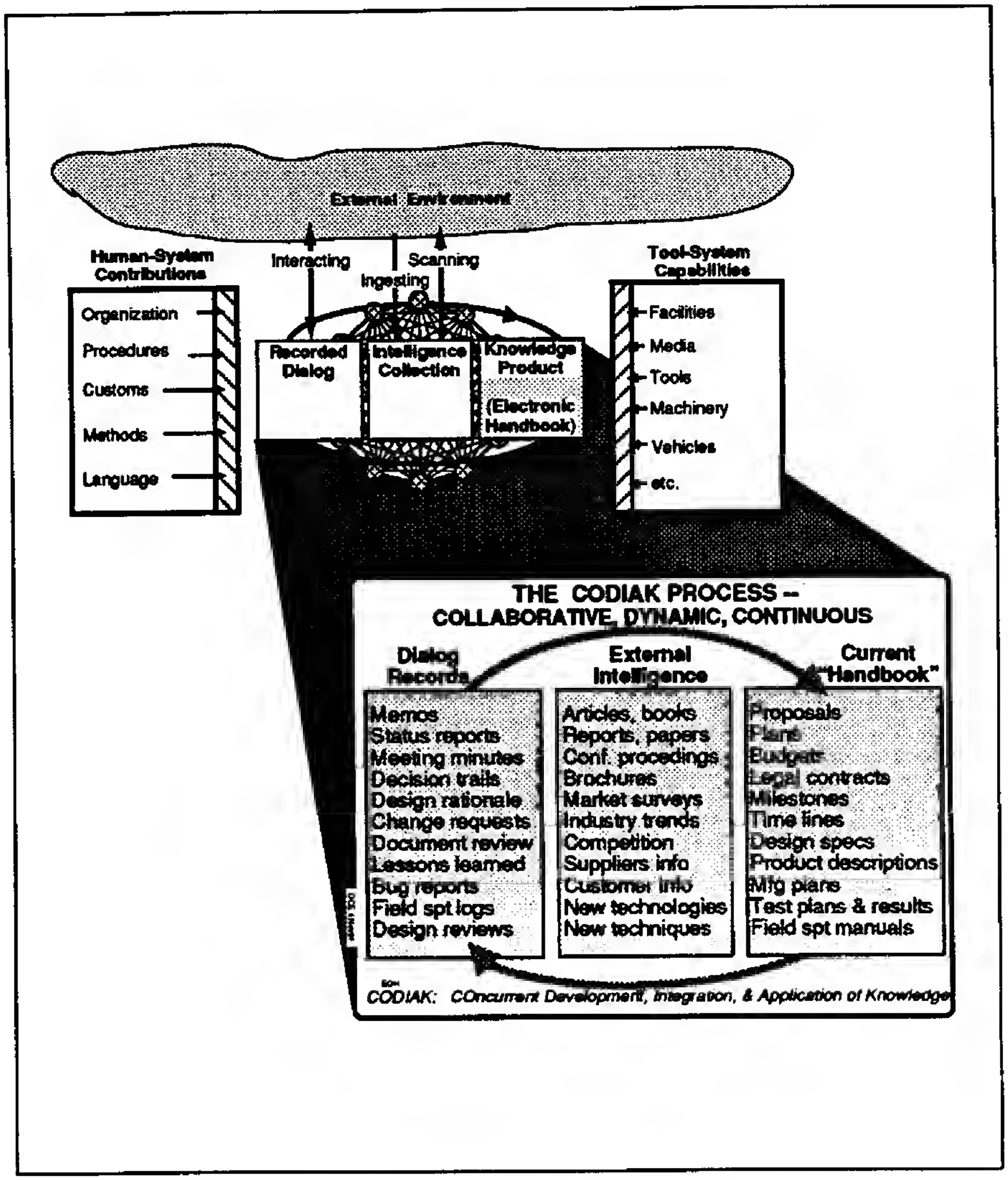
Focus on Improving CODIAK Capabilities

Engelbart suggests that one way to ensure that we co-evolve our human and tools systems is by focusing on improving the CODIAK capability (COncurrent Development, Integration, and Assimilation of Knowledge) within our organizations. It turns out that by continuously improving this capability, we also augment the organization's aptitude for continuous improvement. Therefore, by focusing on improving your company's concurrent development, integration, and assimilation of knowledge, you gain more leverage because you can simultaneously improve the organization's core capaibilities, and at the same time, improve its improvement capability.

P.S.

Doug and I had some interesting discussions about knowledge vs. learning. I wanted to interject the notion of improving organizational learning into this discussion. He prefers to focus on knowledge assimilation and refinement. I feel that CODIAK is the fertile ground out of which learning arises. Doug is concerned that if you indicate that learning supersedes knowledge, people who only understand learning as "static knowledge poured into the head" as opposed to learning as continuous shifting of perceptual filters, learning new distinctions and new practices, will come away without an appreciation of the organic nature of this co-evolutioary augmentation process.

Improved CODIAK will Enhance Co-evolution



Augment human systems' knowledge assimilation capabilities by focusing on improving the organization's CODIAK capabilities in order to co-evolve human and tools systems.

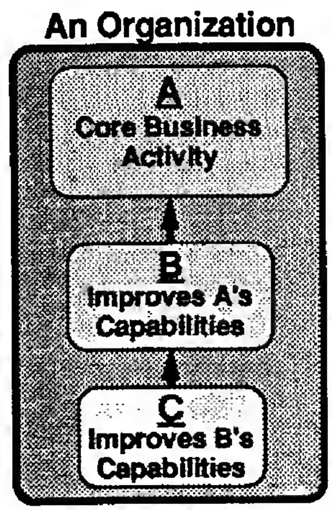
In our last issue, we discussed the design principles for an electronically-enhanced CODIAK capability. Engelbart's point here is that since humans are constantly interacting with information and knowledge in organizations and continuously coordinating their activities, if you focus on capturing those ongoing, living activities and on improving peoples' capabilities to digest and assimilate knowledge, you will dramatically augment that organization's knowledge-refining capabilities.

Bootstrapping Your Way to Improved Organizational Effectiveness

Find the Activity with the Most Leverage

Even if you know that you want to focus on co-evolving your human and tool systems by improving your organization's concurrent development, integration, and assimilation of knowledge, how do you ensure success, given that most organizations are very resistant to change? Doug Engelbart recommends that you use the principle of leverage. Apply your efforts to the area in your organization that will give you the highest pay-off for the smallest investment.

ABCs Of Organizational Improvement



A Activity:
Product R&D, mfg, marketing, sales, accounting, etc. Ex: aerospace -- producing planes; congress -- passing legislation; medicine -- AIDS research.

B Activity:
Improving the organization's ability to perform A work. Ex: introducing email or CAD systems; upgrading quality processes.

C Activity:
Improving the organization's ability to perform B work. Ex: introducing better ways to address needs, or run pilots.

Every organization is actually engaged (simultaneously) in a number of different activities. Engelbart characterizes these as A, B, and C activities---each representing a different focus of attention. If you want to improve the effectiveness of your organization's performance, you must first understand these basic distinctions about the different sorts of activities people are (or should be) engaged in.

A,B, & C Activities within Organizations

Engelbart points out that every business or organization has its core activities—whether those are manufacturing airplanes, marketing soft drinks, or selling and servicing insurance policies. But, within those same organizations, there are activities designed to improve the effectiveness of the core business, such as quality improvement programs. Engelbart suggests that if you focus on improving the

P.S.

In other words, don't start by designing an organization-wide improved CODIAK capability. Instead, start by improving the CODIAK capabilities of your C community. That means, of course, that you first need to identify your B and C communities, and then recruit their interest and commitment to the notion of improving their CODIAK capabilities. Another consultant recently described the C activity as "improving the quality of thinking in the organization." I would still vote for learning, because to me, learning subsumes thinking, knowledge, and continuous improvement.

improvement capability of the organization's core actitvity, you can make a bigger difference with less effort. So he suggests that we focus our attention on improving the B and C capabilities of our organizations.

A, B, & C May Be Different "Hats" on the Same Person

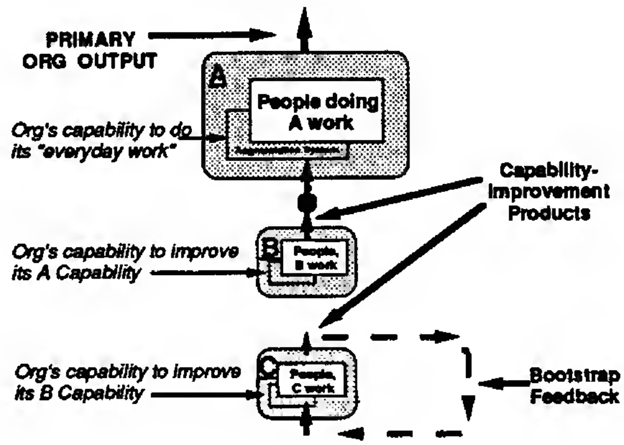
Bear in mind that these activities may be carried out by different groups of people (different line and staff functions), or they may represent the different consciousness we bring to our tasks. If we are simply cranking widgets out on a production line, then we are performing an A activity, but if we are trained to stop work and help solve problems when these arise and to constantly be on the lookout for improvements in the production process, then we are applying our B consciousness to the job. And, if we are leading a quality team and instilling the principles of continuous improvement in the members of that team, we are probably acting out a C role. Engelbart points out that with the rapid pace of change confronting today's organizations, it becomes increasingly important to explicitly identify and focus our attention on the B and C activities. Today's Total Quality Management (TQM) programs provide an excellent example of this trend to explicitly identify quality improvement activities in all areas of your business. For example, to participate in the Baldridge competition, your company needs to demonstrate the way in which continuous improvement is embedded in its budgeting and planning process.

Step-Function Change Required

It's simply not possible to revamp an entire organization simultaneously. We know from experience that we need to roll out changes using a modular, step-function approach. If we are changing over the capital equipment we use in a manufacturing process, we'll start with one plant first, get the new systems up and running, retraining everyone involved, and wait until that is running smoothly before we move onto the next manufacturing site. If dramatic changes need to be made by using this modular approach, where should we begin? What's the highest leverage module we should begin with.?

Bootstrapping Your Way to Improved Organizational Effectiveness

The Principle of Bootstrapping



To me, the notion of bootstrapping implies starting with the basics and feeding on what you learn/earn along the way. Englebart refines this notion by introducing the flywheel approach. Start bootstrapping at the point in the organizational system that will yield the largest amplication in organizational improvement.

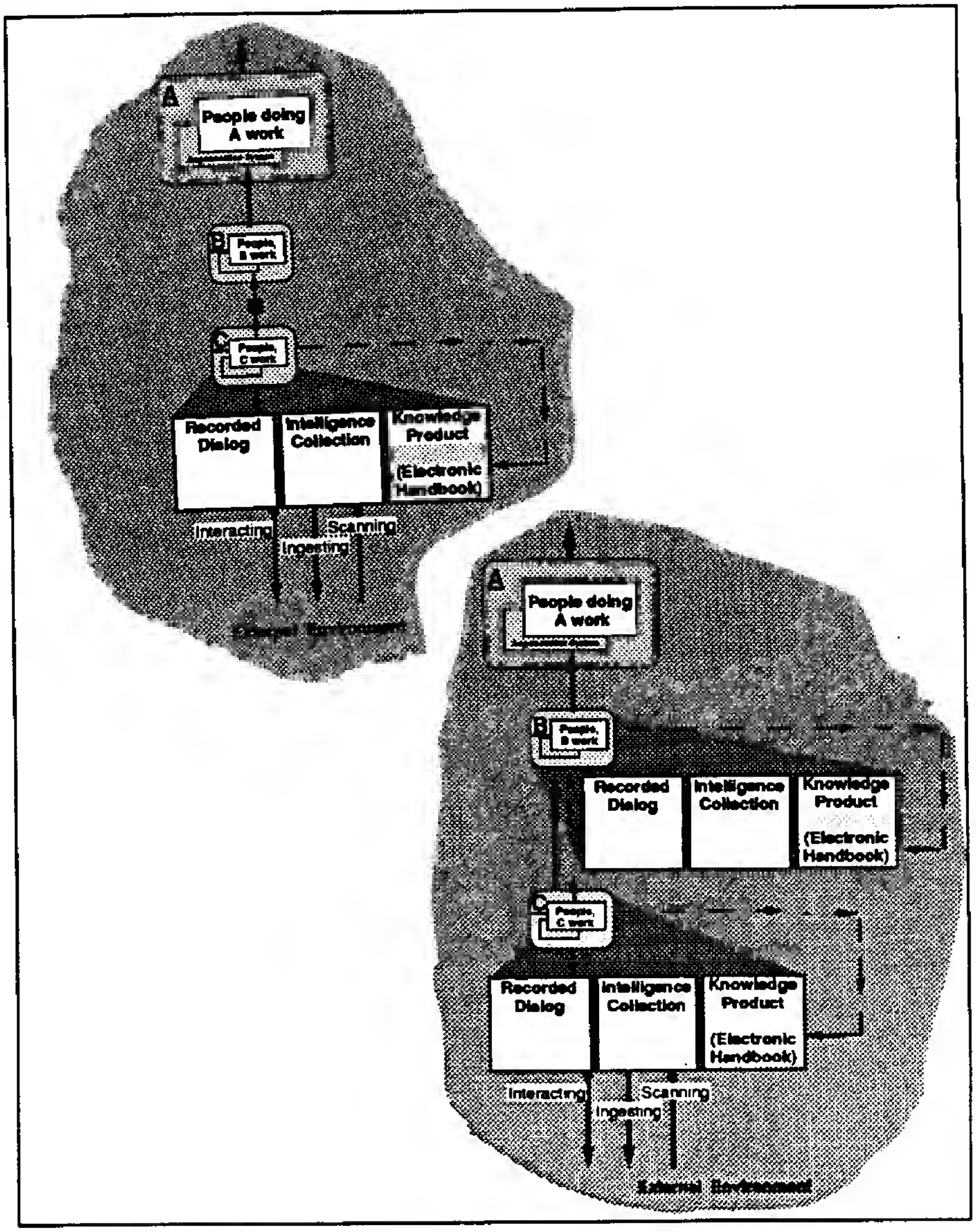
How to Get Started? Identify Your B & C Activities

If you want to improve the capabilities of your knowledge work, then it makes sense to begin with your knowledge workers, and specifically, with those activities that are devoted to your organization's many capability improvement processes. So, you'd start by locating your B activities, and then, from there, finding the C activities supporting the B activities. Then, focus your attention on improving the CODIAK capabilities of those C, B, and A activities (in that order). Engelbart recommends that we focus our attention specifically on improving the organization's ability to concurrently develop, integrate, and apply knowledge. And, as we've already seen, this activity will require the radical co-evolution of both the human systems and the tool systems. Engelbart also feels strongly that, since your organization will get such incredible leverage out of improving its CODIAK capability (to wit, the simultaneous improvement of both core activities and improvement capabilities), this particular C activity should be given a high priority, not be buried in a part-time, low-priority research project.

P.S.

The Bootstrap Institute will also assist you in indentifying or forming a "C" activity within your organization and in forming a C-community across organizations. Doug used to have a single Bootstrap initative he was trying to get off the ground with multi-company participation and sponsorship, but it proved to be too unwieldy to launch, too logistically time-consuming to manage, and too many eggs in one basket.

Focus Attention of C Community on Improving the Organization's CODIAK Capability



What's the best way to improve the organization's improvement capabilities? Improve its CODIAK capability.

Now Doug would prefer to assist various organizations and groups who want to form single or multi-company C communities and hopes that some or all of them will be interested in his coaching on the design of improved Codiak capabilities thru the evolution of an Open Hyperdocument System (see discussion in previous issue). That way he can put his time and attention on the intiatives that are moving most aggressively in the directions he feels will have a high payoff.

Bootstrapping Your Way to Improved Organizational Effectiveness

Help from The Bootstrap Institute

Doug Engelbart's Bootstrap Institute offers consulting and mentoring services to organizations ready to embark on a bootstrapping initiative. The first step, according to Engelbart, is to identify the B and C activities within your organization and begin to explore ways to improve your own organizational improvement capabilities. It is important, Engelbart feels, that this be given a high priority by senior executives. For companies (user or vendor organizations) who are giving serious consideration to understanding and implementing an improved framework for concurrent knowledge work, Engelbart is also available to play the role of consultant and mentor. He will recommend, of course, that two initiatives be tied together—your organizational improvement efforts, and the improved CODIAK design efforts.

How do I Get More Information?

Contact

The Bootstrap Institute:
6505 Kaiser Drive, Fremont, CA 94555
Phone: (510) 713-3550; Fax: (510) 793-2362
Email: Info@ Bootstrap.stanford.edu

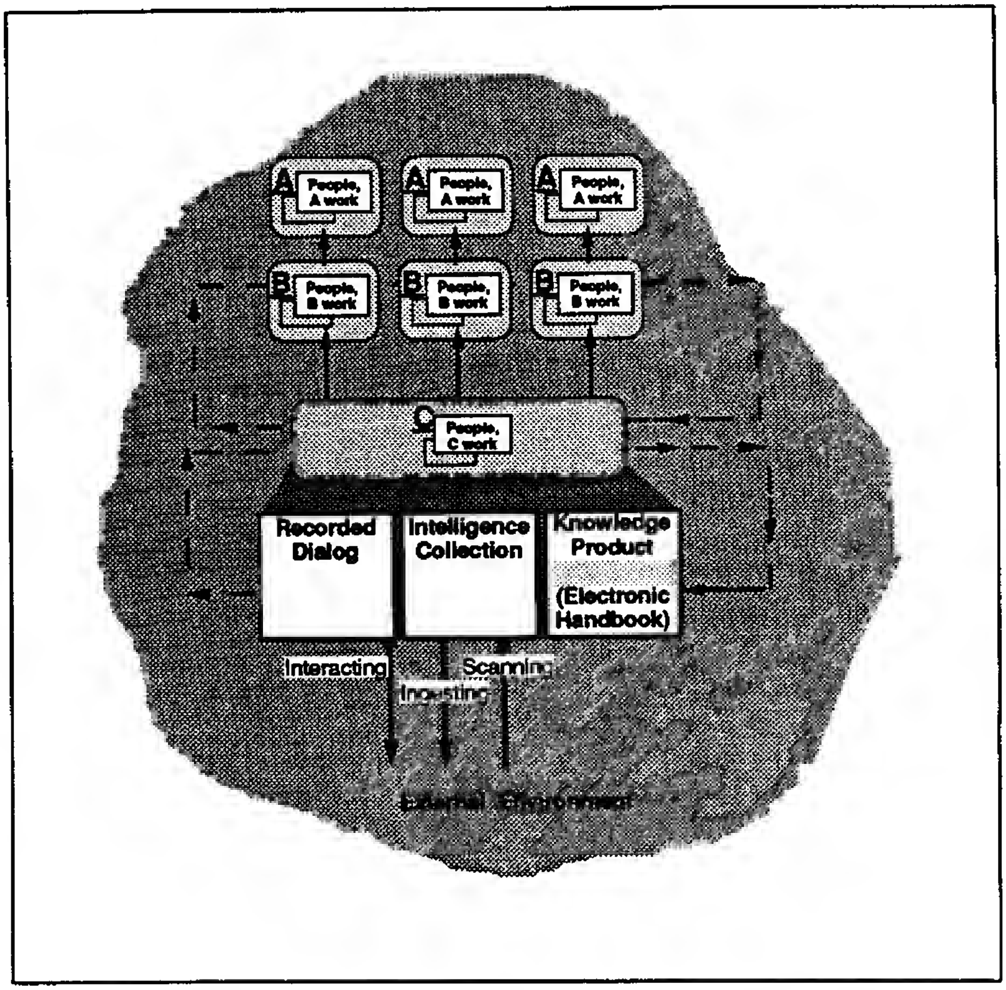
Form a C Community across Organizations

The real brilliance of Doug Engelbart's recipe for success, in my opinion, is his recommendation that organizations should interlink their C activities. Imagine, if you will, tens or even hundreds of organizations committed to improving their companies' abilities to concurrently develop, integrate and apply knowledge. And imagine what would happen if the C communities of those organizations all joined forces to collaborate, to share learning and experiences, and to develop, assimilate, and disseminate knowledge about their findings. Further imagine what would happen if the tools and methods that meta-C community used in its work across its organizations could also serve as a pilot program for improving the CODIAK capabilities *within* its organizations. That is the essence of Doug Engelbart's Bootstrap concept. If a group of organizations' C communities were to combine forces to invest in developing and experiencing an improved CODIAK capability, the costs involved would be relatively modest, because they could be shared across multiple organizations. Yet, the benefits to each participating organization would be tremendous—benefits that would accrue first from identifying and empowering their B and C activities, and second from investing in improving the concurrent knowledge capabilities of the C community, thereby empowering those C communities to improve their capabilities to improve their organizations' improvement capabilties. This bootstrapping framework could serve as a launching pad for the further development of true collaborative knowledge-based organizations.

P.S.

Does this idea intrigue you? Do you already have identifiable B & C activities within your organization? Is there a cross-divisional or cross-organizational collection of these C activities to which you currently belong that is already acting like a common community of practice? If so, and if you'd like to consider augmenting the effectiveness of that C Community by piloting better CODIAK capabilities, or if you'd like to form or to join such a community of practice, contact Doug Engelbart.

The Best Leverage; a C Community across Organizations with Enhanced CODIAK Capabilities



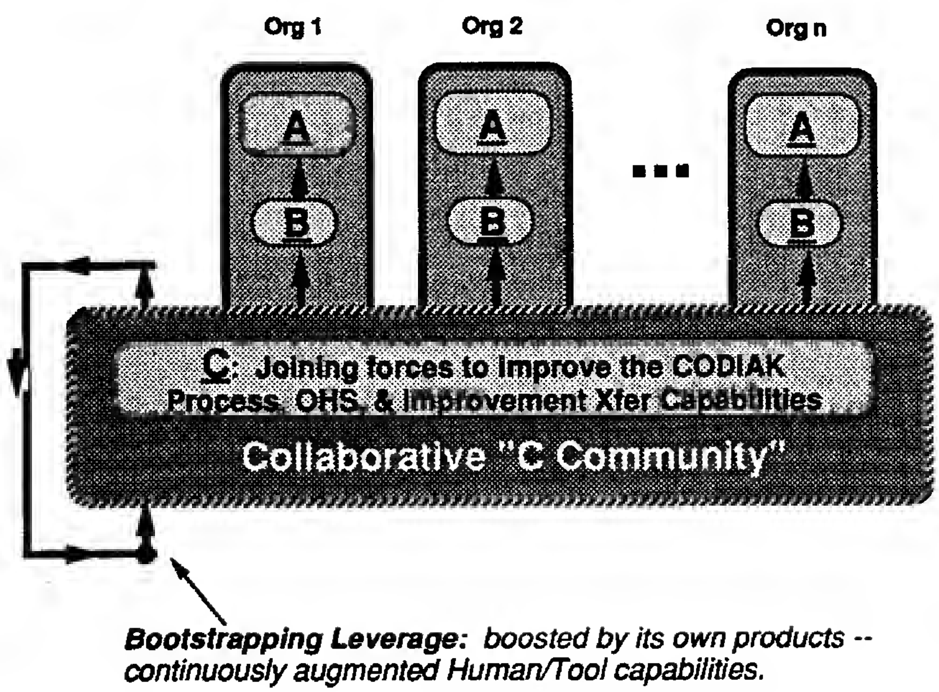
Form a C Community With Seybold (& Engelbart)

Engelbart hopes that over the next few years, as organizations begin to focus their attention on improving their abilities to concurrently develop, integrate, and apply knowledge, they will naturally find allies in other organizations which have started down the same path, and that a number of active cross-organizational C Communities will emerge. We, at the Office Computing Group, are interested in facilitating the formation of at least one of these C communities. Our own focus is likely to be influenced by our own early experience (and that of some of our customers) in the use of Lotus' Notes as an early CODIAK prototype. But we would welcome organizations using other tools to augment their CODIAK capabilities as well, so we can develop a better understanding of many of the cross-system interoperability issues that will be impacted by collaborative knowledge work.

Remember in the last issue, we talked about the need for Open HyperDocument System standards that would go deeper into the behavioural aspects of open systems (common navigational paradigms, common grammar, common object methods, increased granularity of objects and increased accuracy of addressability of links and objects). Doug feels, and I agree, that you can't come up with meaningful standards in a vacuum. Instead, we need to build a body of experience using the most advanced hyperlinking and knowledge-management systems we can build, find, and gain access to in order to set standards priorities.

Bootstrapping Your Way to Improved Organizational Effectiveness

The C Community as an Advanced Pilot



This is where the notions of Bootstrapping, CODIAK, OHS and the C Community come together. You form a cross-organizational dedicated and committed C Community. Then, you make the first activity of that C community be the design, implementation, use, and refinement of an advanced CODIAK capability to serve them and to improve their ability to help the B's and A's they serve within their own organizations. Out of this CODIAK design and piloting activity would come the specifications for an Open HyperDocument System that could be implemented across technology platforms and organizations.

P.S.

Interested in joining us?

A "C-Bold" Community? Doug Engelbart recommends, tongue in cheek, that we call our Seybold C Community Initiative, the C-Bold Initiative. What would such a C community look like? We envision it as a group of organizations that have committed themselves to:

1. Balanced co-evolution of their own human and systems tools,

2. Improving their cabiliities to concurrently develop, integrate, and assimilate

3. Identifying and empowering a C community within their organizations whose focus will be to improve each organization's ability to improve its core competencies by concentrating on improving the collection, sharing, and dissemination of knowledge within the organization,

4. Pooling their resources and sharing knowledge by empowering their C groups to work collaborattively with the C groups in other organizations,

5. Piloting improved human and systems tools along with other members of the meta-C community in order to test the principles for improved CODIAK capabilities.

6. Working with members of the C-Community to apply the experiences learned from piloting improved CODIAK systems towards the development of better standards in the form of an Open HyperDocument Specification. And feeding those specifications and requirements directly into the standards development bodies, such as the Object Management Group, the Open Software Foundation, X/Open, NIST, OSI, and so on., in addition to working with system and software designers to incorporate users' requirements in the domain of collaborative knowledge work into their evolving products.

Please let me know—
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TOWARD HIGH-PERFORMANCE ORGANIZATIONS: A STRATEGIC ROLE FOR GROUPWARE

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Document #: (AUGMENT,132810,)

ABSTRACT

Achieving tomorrow's high-performance organizations will involve massive changes throughout their capability infrastructures. The complexity of implementing these changes will be daunting, and deserves a strategic approach. Groupware will support important, special new knowledge capabilities in these infrastructures, and also can play a key role in an evolutionary strategy.

1 INTRODUCTION

1.1 Shared Visions and the "Groupware Community"

Groupware to me, personally, is a strategic means to an important end: creating truly high-performance human organizations. My pursuit began in the '50s, aiming to make our organizations and institutions better able to handle complexity and urgency. By 1962 I had evolved a basic conceptual framework for pursuing that goal (Ref-1 and Ref-2). I have essentially lived and worked within that framework ever since, steadily evolving and enriching it via many relevant experiences.

It is becoming relatively common of late, in the increasing flow of literature about organizational improvement, to highlight the need for the members of an organization to have a shared vision of where and how the organization is moving, in its marketplace and in its internal evolution. I assume that the same principle should be applicable to a looser organizational unit, in this case, to the community consisting of organizations and researchers interested in the overlapping domains of organizational improvement and "groupware," and including the information-system marketplace whose business is providing products and services to end-user organizations.

From my experience, the nature of this shared vision will be the single most important factor in how directly and how well the digital-technology marketplace will indeed support significantly higher organizational capability — which I assume is our basic objective in the evolution of groupware.

My own vision about pursuing high-performance organizations has matured over the years into a quite comprehensive, multi-faceted, strategic framework. It may seem a bit radical in nature, but my continuing hope is that it will be merged into such a shared community vision.

The full purpose of our Bootstrap Institute is to promote constructive dialog with critical stakeholders in the community about this "bootstrap strategy," to facilitate its trial adoption, and to further the strategy's own "continuous improvement."

In this paper I summarize the key elements of this strategic framework and highlight the role that would be played by the "groupware community." In Ref-3 is an explicit historical treatment that provides a good deal of background on framework development up to 1986. Also, Ref-4 gives a relatively balanced description of our associated groupware and application developments with an underlying framework treatment.

1.2 Capability Infrastructure and its Augmentation System

Any high-level capability needed by an organization rests atop a broad and deep *capability infrastructure*, comprised of many layers of composite capabilities, each depending upon the integration of lower-level capabilities. At the lower levels lie two categories of capabilities: Human-Based and Tool-Based. The functional capabilities of groupware fit into the latter category, along with a wide variety of facilities, artifacts, and other tools.

In pursuit of higher organizational performance, this infrastructure is the obvious focus of attention. Then it is a matter of establishing system and goal perspectives to determine how much of this infrastructure to include as serious candidates for change, and how radical a change to contemplate. I arrived at a singularly global perspective from the following considerations.

Figure 1 shows the result of a great deal of thought about how over the centuries our cultures have evolved rich systems of things that, when humans are conditioned and trained to employ them, will *augment* their basic, genetically endowed capabilities so that they, and their organizations, can exercise capabilities of much higher nature than would otherwise be possible. For lack of a ready-made term, I named this our *Augmentation System*, and found it valuable to partition it into the two parts as shown — a Human System and a Tool System. I have developed many things from this model that have proved useful and valid over the years — including essentially everything I've developed in the groupware arena (tools, concepts, strategies).

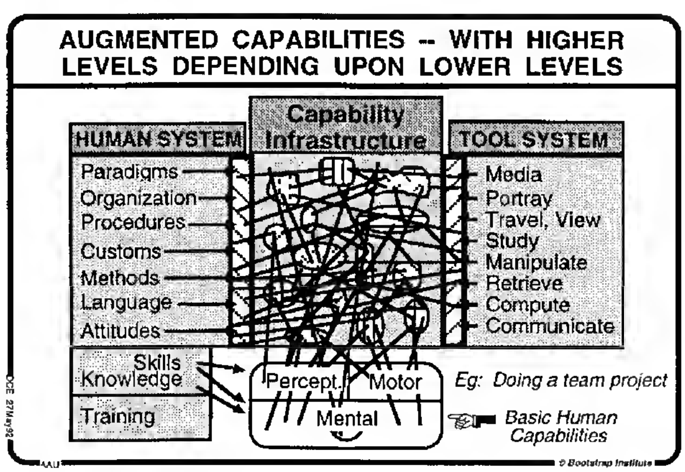

Figure 1

A bit of thinking about this model brought me the realization that we are far short of being able to do a one-pass re-design of any major portion of this capability infrastructure — if only because of their pervasive, underlying dependence upon human processes.

And as we pursue significant capability improvement, we need to appreciate that we will be trying to affect the evolution of a very large and complex system that has a life and evolutionary dynamic of its own. Concurrent evolution of many parts of the system will be going on anyway (as it has for centuries). We will have to go along with that situation, and pursue our improvement objectives via facilitation and guidance of these evolutionary processes. Therefore, we should become especially oriented to pursuing improvement as a multi-element, *co-evolution* process. In particular, we need to give explicit attention to the co-evolution of the Tool System and the Human System.

And, along with these foregoing perceptions, another factor popped into the scene to create a very significant effect on my emergent framework.

1.3 The Relevant Implications of Radical Scale Change

Some years earlier, I had studied the issues and prospects associated with extreme miniaturization of functional devices, towards assessing the likelihood of digital equipment becoming extremely small, fast and cheap. I was personally motivated because I would have to be relatively confident of very significant progress in that regard in order to commit a career towards facilitating widespread computer augmentation.

I learned enough to convince myself that, with the expected high industrial and military demand toward digital technology, the achievable limits on micro scalability were far beyond what would be enough to warrant my particular pursuits. And in the process, looking into references dealing with dimensional scale in living things, I became aware of a very important general principle: if the scale is changed for critical parameters within a complex system, the effects will at first appear as quantitative changes in general appearance, but after a certain point, further scale change in these parameters will yield ever-more striking *qualitative* changes in the system.

For example: The appropriate design for a five-foot creature is not that much different from that for a six-foot creature. But the design for either of these would be totally inappropriate for a one-inch creature, or for a thirty-foot creature. A mosquito as big as a human couldn't stand, fly or breathe. A human the size of a mosquito would be badly equipped for basic mobility, and for instance would not be able to drink from a puddle without struggling to break the surface tension, and then if his face were wetted, would very likely get pulled under and be unable to escape drowning.

The lesson: Expect surprising qualitative changes in structural assemblage and functional performance when a complex system adapts effectively to drastic changes in critical parameters.

I could only assume that the same is very likely to be true for the complex Augmentation System that supports an organization's capability infrastructure. Here, the radical change in the scale of Tool System capability — in speed, function, capacity, presentation quality, transmission, etc. of emergent digital technology — greatly transcends any other perturbation in system parameters that our organizations have ever needed to adapt to in so short a time as a few decades.

Much more could be said about the scaling issue that is relevant to the general theme of organizational change. Sufficient here to say that these thoughts drove me definitely to

view as global and massive both the opportunity and the challenge that we humans were facing with respect to increasing the performance level of the organizations and institutions upon which mankind's continuing existence depends.

1.4 The Underlying Importance of Paradigms

In the ensuing thirty years since the model of Figure 1 first evolved, I have become ever more convinced that human organizations can be transformed into much higher levels of capability. These digital technologies, which we have barely learned to harness, represent a totally new type of nervous system around which there can evolve new, higher forms of social organisms.

In the face of mounting evidence that our organizations and institutions can not cope adequately with the increasing complexity and urgency of our society's problems, it seems highly motivating to explore every avenue that offers reasonable probability of improving their capability to cope.

Those were my thoughts thirty years ago; they seem even more germane today. The technologies have been demonstrated, and our organizations are aligning toward internal improvement. What seems still to be lacking is an appropriate general perception that:

(a) huge changes are likely, and really significant improvements are possible;

(b) surprising qualitative changes may be involved in acquiring higher performance; and

(c) there might actually be an effective, pragmatic strategy for pursuing those improvements.

In developing a basic, scalable strategy, the above issues of perception are important enough to warrant being explicitly factored into it. In other words, the strategy should provide for the need of significant shifts in our perception of our likely and possible futures.

Perceptions, shared visions, paradigms — their evolution is *critical*, yet they receive little or no direct developmental attention. The slow, un-shepherded paradigm drifting of the past isn't an adequate process for times when deeper global changes are occurring than ever-before accommodated by such massive social bodies. And the rates of such change are more likely to increase than to diminish.

I interject such thoughts here because I actually believe that what can be produced by the groupware community can make a very large difference (in a proper strategic framework) to our capability for coping with large, complex problems. The ability to acquire this new capability is heavily dependent upon evolving an appropriate paradigm, which result in itself represents the type of complex challenge that our institutions need to become more capable of handling.

This leads to an assumption that an important factor to hope for, in an early stage of the future paradigms possessed by key players in this transformation of our organizations, is the perception of importance and a can-do attitude about consciously cultivating appropriate evolutionary trends and change rates in our future paradigms. Shifting our paradigm about paradigms.

What role will *you* play?

2 IMPROVING THE IMPROVEMENT PROCESS

The next step in developing an explicit strategic framework was generated from the conceptual content of Figure 1 by asking what sort of investment principles would make sense. I hoped to solicit R&D money and wondered how we might get the best return on those funds in facing this very large, unstructured problem. I also was prepared to invest essentially the rest of my professional career: how should I invest that time to get best net progress? And what basic guidelines should be adopted for launching (bare handed, so to speak) such a program?

The only serious approach that I could imagine, towards really significant improvement, would be a long-term, pragmatically guided, whole-system evolution. I was addressing a very complex system, and the challenge would be further complicated by the fact that the subject organizations would have to keep functioning at better than survival level while undergoing large, systemic changes.

So the image depicted in Figure 2 emerged from realizing that the capability of an organization to improve itself would have to become much more prominent and effective. It then seemed natural to consider a strategy wherein the earliest improvement efforts might be concentrated upon improving this capability (i.e., to improve the organization's improvement capability).

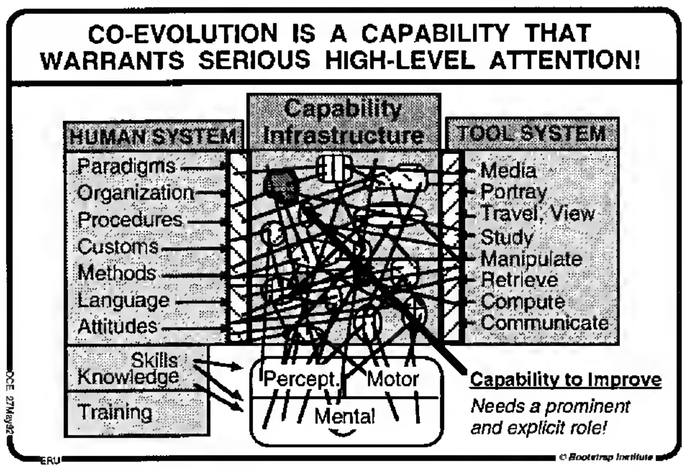

Figure 2

3 THE ABC MODEL OF ORGANIZATIONAL IMPROVEMENT

In doing some further thinking about improvement activities and the capabilities that support them, I found it useful to extract from Figure 2 a simpler abstraction dealing with organizational improvement, as in Figure 3. Here we separate the two types of activities, *A* and *B*, and show that the capability for each type of work is supported by its respective Augmentation System (comprised of Human and Tool systems).

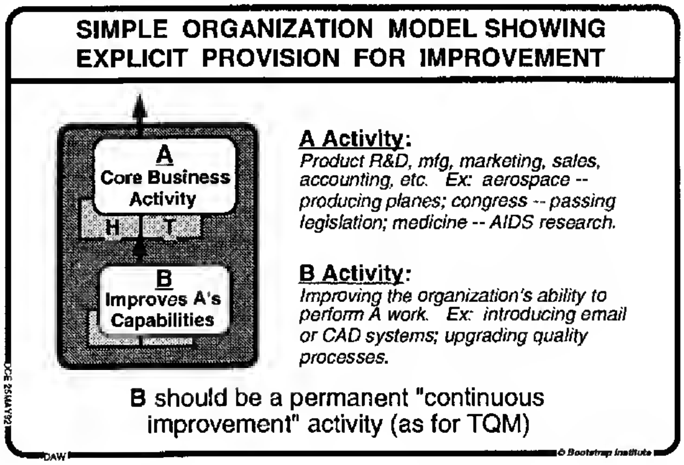

Figure 3

Given this model, we can now consider the prospects of improving the organization's improvement capability, as discussed earlier in Figure 2, as *improving the capability of the B Activity*. And for such a critical pursuit to be effective requires yet another explicit organizational activity, depicted in Figure 4 as the organization's C Activity. Executive efforts to assess and improve B-Activity funding, staffing, and high-level approach would qualify as a C Activity. C Activities would also include introducing new knowledge and skills into the B Activity, providing better means for participatory interaction with its A-Activity clients, or improving how pilot operations are managed.

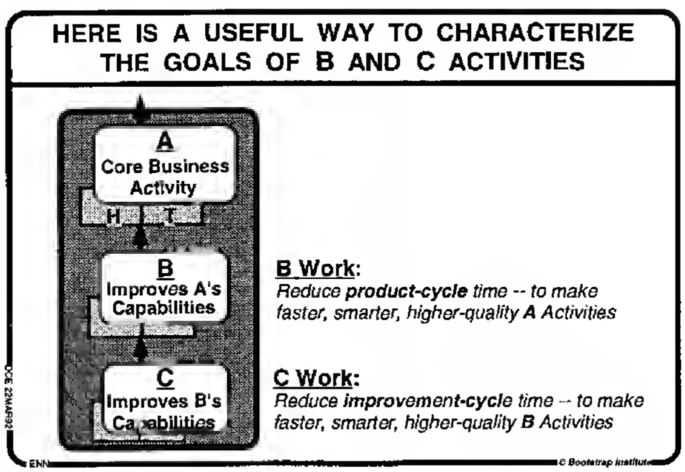

Figure 4

4 LOOKING FOR A MULTI-PAYOFF CAPABILITY CLUSTER

In considering the infrastructure elements that support this higher-level, self-improvement B Capability, I realized that many of its important subordinate capabilities are also actively employed by many of the higher-level A Capabilities that are important to the basic operations of the organization. For example, identifying needs and opportunities, designing and deploying solutions, and integrating lessons learned. This led to the following rhetorical question:

> *Is there a set of basic capabilities whose improvement would significantly enhance both the higher-level operational A Capabilities and this self-improvement B Capability?*

The answer was a clear "Yes!" A core set of knowledge-related capabilities rapidly emerged as the prime candidate.

An investment that boosts the A Capability provides a one-shot boost. An investment that boosts the B Capability boosts the subsequent rate by which the A Capability increases. And an investment that boosts the C Capability boosts the rate at which the rate of improvement can increase. (To be slightly mathematical, investing in B and C boosts respectively the first and second derivative of the improvement curve — single and double compounding, if you wish.)

We are assuming here that selected products of the two capability-improvement activities (B and C) can be utilized not only to boost the capabilities of their client activities, but can also to a significant extent be harnessed within their own activities to boost their subsequent capability. This is depicted in Figure 5 by the "feedback" paths.

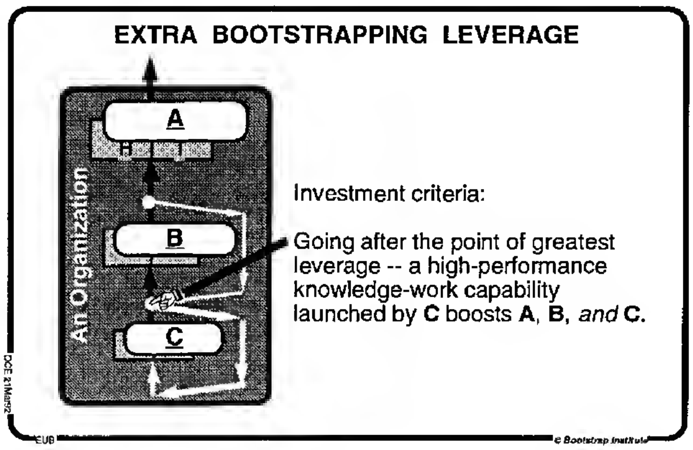

Figure 5

This was where the term *bootstrapping* became welded into my continuing professional framework. It turns out that there are many choices that we will face where balanced consideration of the bootstrapping possibilities can make a difference. I place much confidence in the potential payoff from thoughtful application of the principles that have evolved from such thinking.

5 THE CODIAK PROCESS CLUSTER: BEST STRATEGIC APPLICATION CANDIDATE

Over the years I have tried various ways to label and characterize the above-mentioned key knowledge capabilities. For lack of an established term, I have settled on an acronym that embraces the main concepts of this cluster of high-leverage capabilities — *CODIAK*:

The concurrent development, integration and application of knowledge.

As complexity and urgency increase, the need for highly effective CODIAK capabilities will become increasingly urgent. Increased pressure for reduced product cycle time, and for more and more work to be done concurrently, is forcing unprecedented coordination across project functions and organizational boundaries. Yet most organizations do not have a comprehensive picture of what knowledge work is, and of which aspects would be most profitable to improve.

The CODIAK capability is not only the basic machinery that propels our organizations, it also provides the key capabilities for their steering, navigating and self repair. And the body

of applicable knowledge developed represents a critically valuable *asset*. The CODIAK capability is crucial in most A Activities across the organization, whether in strategic planning, marketing, R&D, production, customer support, or operations. It is also crucial in the B and C Activities, whether identifying needs and opportunities, designing and deploying solutions, or incorporating lessons learned — which of course is also used in key A-Activity work. As such, the CODIAK capability should be considered a core business competency in the organization's capability infrastructure, and is an ideal candidate for early improvement to achieve the extra bootstrapping leverage discussed above in Figure 5.

For best exposure to full CODIAK issues, it helps to consider heavy knowledge-intensive activities such as a large, complex project. Figure 6 represents the high-level core of such a CODIAK process. In the center is a basic organizational unit, representing the interactive knowledge domains of a single individual, or of individuals or groups within a project team, department, functional unit, division, task force, committee, whole organization, community, or association (any of which might be inter- or intra- organizational).

Each organizational unit is continuously analyzing, digesting, integrating, collaborating, developing, applying, and re-using its knowledge, much of which is ingested from its external environment (which could be outside of, or within, the same organization).

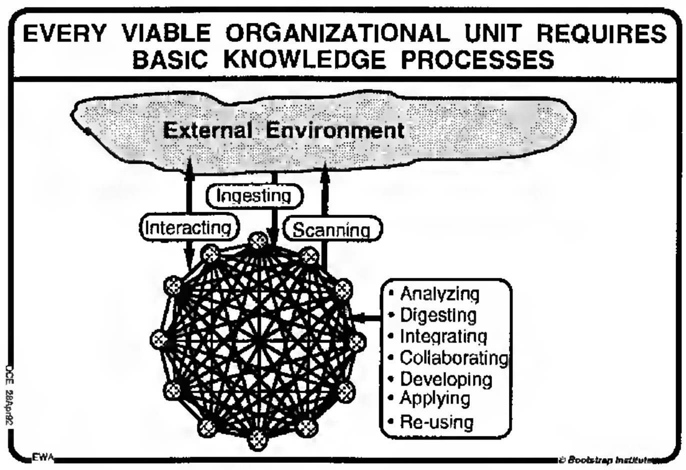

Figure 6 *CODIAK: The COncurrent Development, Integration, & Application of Knowledge*

A result of this continuous knowledge process is a dynamically evolving knowledge base as shown in Figure 7 below, consisting of three primary knowledge domains: intelligence, dialog records, and knowledge products (in this example, the design and support documents for a complex product).

Intelligence Collection: An alert project group, whether classified as an A, B, or C Activity, always keeps a watchful eye on its external environment, actively surveying, ingesting, and interacting with it. The resulting *intelligence* is integrated with other project knowledge on an ongoing basis to identify problems, needs, and opportunities which might require attention or action.

Dialog Records: Responding effectively to needs and opportunities involves a high degree of coordination and *dialog* within and across project groups. This dialog, along with resulting decisions, is integrated with other project knowledge on a continuing basis.

Knowledge Product: The resulting plans provide a comprehensive picture of the project at hand, including proposals, specifications, descriptions, work breakdown structures, mile-

stones, time lines, staffing, facility requirements, budgets, and so on. These documents, which are iteratively and collaboratively developed, represent the *knowledge products* of the project team, and constitute both the current project status and a roadmap for implementation and deployment. The CODIAK process is rarely a one-shot effort. Lessons learned, as well as intelligence and dialog, must be constantly analyzed, digested, and integrated into the knowledge products throughout the life cycle of the project.

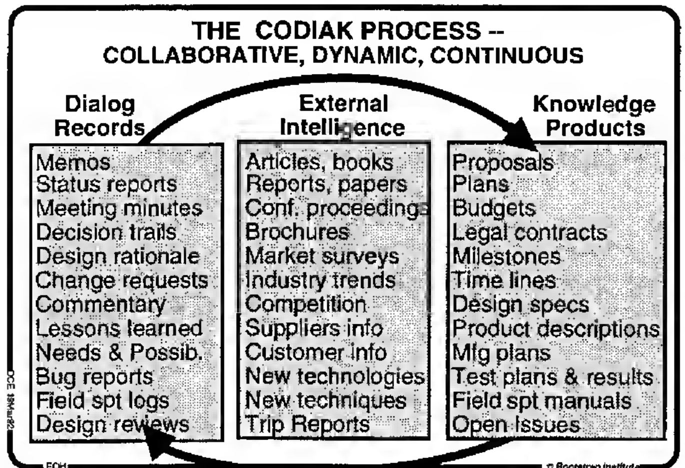

Figure 7

CODIAK: COncurrent Development, Integration, & Application of Knowledge.

With minor adjustments in the boxed lists in Figure 7, this basic generic CODIAK model seems to apply equally well to academic scholarship, heavy industry, government, medical research, social institutions, consumer product businesses, consulting firms, trade associations, small non-profits, and so on.

We need to note here that basic CODIAK processes have practically forever been a part of society's activity. Whether the knowledge components are carried in peoples' heads, marked on clay tablets, or held in computers, the basic CODIAK process has always been important.

What is new is a focus toward harnessing technology to achieve truly high-performance CODIAK capability. As we concurrently evolve our human-system elements and the emergent groupware technology, we will see the content and dynamics represented in Figure 7 undergo very significant changes.

More and more intelligence and dialog records will end up usefully recorded and integrated; participants will steadily develop skills and adopt practices that increase the utility they derive from the increased content, while at the same time making their contributions more complete and valuable.

Generally, I expect people to be surprised by how much value will be derived from the use of these future tools, by the ways the value is derived, and by how "natural and easy to use" the practices and tools will seem after they have become well established (even though they may initially be viewed as unnatural and hard to learn).

Inevitably, the groupware tools which support the CODIAK processes within and across our organizations will need to be fully integrated and fully interoperable. Consider the larger

organization depicted in Figure 8 in which our representative complex project may be embedded (for example, in the Engineering Department of a manufacturing organization).

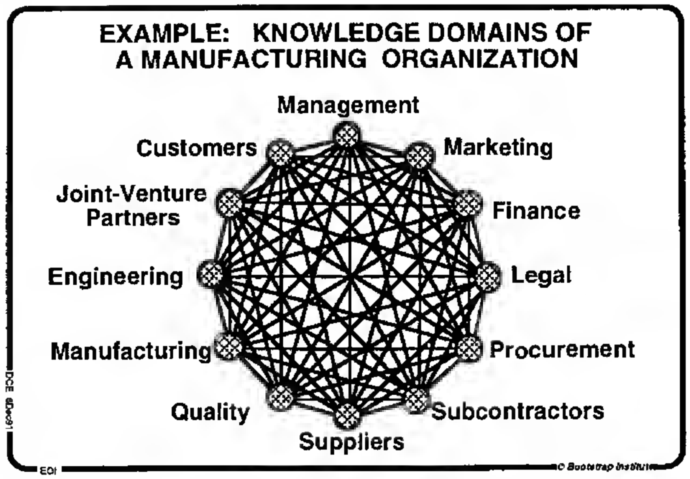

Figure 8 *Enterprise integration: Interoperability within & across knowledge domains*

Each of the enterprise's functional units studded around the circle represents an activity domain that houses at least one CODIAK process. Then, because of their mutual involvement with the operations of the whole enterprise, the CODIAK processes within each of these enterprise sub-domains would with strong likelihood benefit from being interoperable with those of the other sub-domains.

As operations between enterprises steadily become more closely knit, the interaction processes with customers, subcontractors and suppliers also want to become increasingly effective — and therefore the issue of knowledge-domain interoperability becomes ever more global.

As developed in the sections that follow, our framework assumes that all of the knowledge media and operations indicated in Figure 7 will one day be embedded within an Open Hyperdocument System (OHS). Every participant will work through the windows of his or her workstation into his or her group's "knowledge workshop."

With this in mind, consider the way in which the project group's CODIAK domain, with all of its internal concurrent activity, will be operating within the larger enterprise group depicted in Figure 8.

And consider that the whole enterprise, acting as a coherent organizational unit, must also have a workable CODIAK capability and possess its own evolving, applicable CODIAK knowledge base.

Here an important appreciation may be gained for the "concurrency" part of the CODIAK definition. CODIAK was introduced above with the sense that all of the development, integration and application activities within a given organizational unit were going on concurrently. *This establishes a very important requirement for the groupware support.*

In Figure 9 we get the sense of the multi-level "nesting" of concurrent CODIAK processes within the larger enterprise. Each of the multiply-nested organizational units needs its own coherent CODIAK process and knowledge base; and each unit is running its CODIAK processes concurrently, not only with all of its sibling and cousin units -- but also with larger units in which it is embedded, and with smaller units that are part of its own makeup.

Furthermore, there are many valuable organizational units that cut across the organizational structure — such as a corporate-wide task force — and each of these units also needs a coherent CODIAK process and knowledge base. And beyond that, significant working relationships will be going on with external organizational units, such as trade associations, professional societies, consultants, contractors, suppliers, special alliance partners, customers, regulatory agencies, and standards groups. Each such "external" unit needs to have a coherent CODIAK knowledge domain; all such domains will have some knowledge elements and evolutionary dynamics that are mutual with those of many other units in the enterprise's total CODIAK environment.

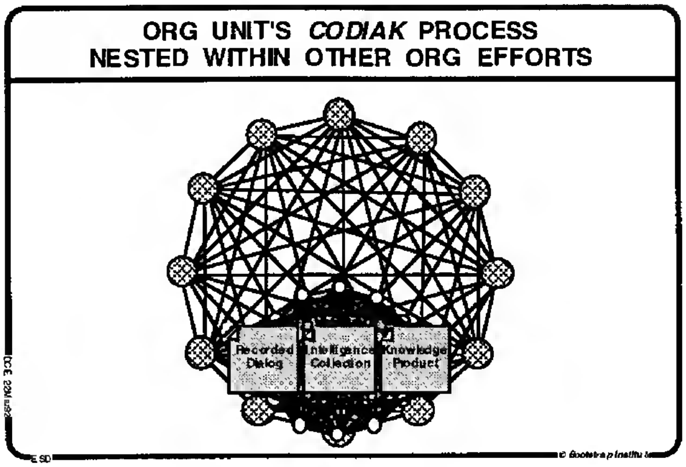

Figure 9

So, consider the much extended sense of concurrency and inter-dependency arising from the above picture: the CODIAK processes of all of the inter-dependent organizational units within the larger enterprise are going on concurrently; and further, among these concurrently active processes there is a great deal of mutual involvement with parts of the whole knowledge base.

It is easy to realize that significant parts of what the smaller group works with, as being in its "external environment" intelligence collection, will actually be shared-access knowledge from other domains within the enterprise — from other's dialog, from their external intelligence, or from their finished or evolving knowledge products.

Then the entire enterprise has a collective CODIAK domain, with knowledge elements that to some extent will be actually in a "whole-enterprise" domain, but where much of what lies in the collective enterprise domain is an active part of the CODIAK domains of subordinate organizational units within the enterprise.

And further, consider that as the availability of highly effective online CODIAK support becomes widespread, suppliers, contractors and customers will engage in a non-trivial degree of CODIAK-domain sharing with the enterprise. One needs only a brief glance at the supplier network of Figure 10 to realize the magnitude of critical, interoperable CODIAK processes and shared CODIAK knowledge domains that will prevail when (or if) suitable groupware becomes widely available.

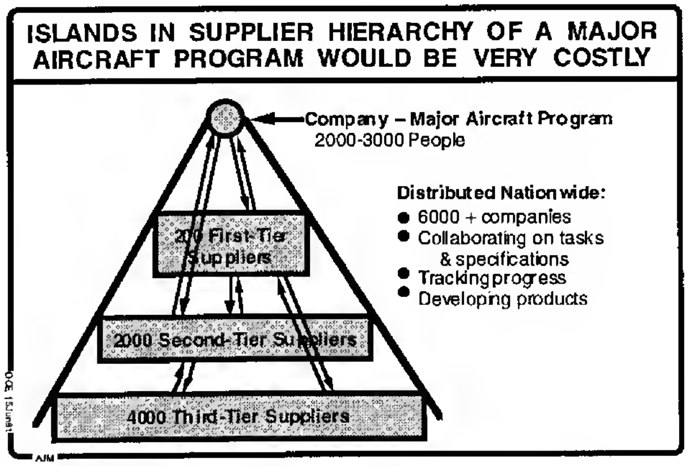

Figure 10

This is representative of the scale of global challenge that I think faces the groupware marketplace.

The foregoing dictates some very significant requirements for any groupware system that attempts to support the CODIAK processes of our future, high-performance organizations. Immediately apparent is the need for very flexible, wide-area sharing of pieces of the knowledge base. What has only recently begun to be generally apparent is the associated need for a new way of thinking about the nature of the knowledge packages we have called "documents." This above requirement for flexibly arranged sharing of essentially arbitrary knowledge chunks provides a very strong argument for documents becoming built from modular-concept nodes with arbitrary inter-node linking — *hypertext*.

So, how (and when) will the marketplace learn enough and be cooperative enough to develop truly effective OHS standards? The prospects for achieving truly high levels of performance in larger organizations and institutions pretty much await that day.

> This question is a significant part of what an effective bootstrapping strategy needs to address.

6 OPEN HYPERDOCUMENT SYSTEM (OHS): FOR GENERIC CODIAK SUPPORT

My early assumption, amply borne out by subsequent experience, is that the basic supporting technology for future high-performance knowledge work will be an integrated system based upon multi-media hyperdocuments.

Furthermore, there will be critical issues of interoperability within and between our organizations and their knowledge domains. The ever-greater value derived from online, interactive work within a hyperdocument environment will require a significantly higher degree of standardization in document architecture and usage conventions than heretofore contemplated.

It is inevitable that this service be provided by an "open system" of hyperdocuments and associated network and server architectures. The basic arguments for this Open Hyperdocument System (OHS) are presented in Ref-5; and the hyperdocument system features described below are assumed by me to be strong candidates for requirements for the eventual OHS whose evolution will be so critical to the productivity of industries and nations.

Following is a brief general description of the system design that has evolved from the conceptual orientation described in this paper, through the experience of many years and trial events. Please note that the term "system" is very important here.

Shared Files/Documents — the most fundamental requirement. Generalized file sharing is to be available across the entire global domain in which any online collaborative working relationship is established (e.g., world-wide).

Mixed-Object Documents — to provide for an arbitrary mix of text, diagrams, equations, tables, raster-scan images (single frames or live video), spread sheets, recorded sound, etc. — all bundled within a common "envelope" to be stored, transmitted, read (played) and printed as a coherent entity called a "document."

Explicitly Structured Documents — where the objects comprising a document are arranged in an explicit hierarchical structure, and compound-object substructures may be explicitly addressed for access or to manipulate the structural relationships.

Global, Human-Understandable, Object Addresses — in principle, every object that someone might validly want/need to cite should have an unambiguous address, capable of being portrayed in a manner as to be human readable and interpretable. (E.g., not acceptable to be unable to link to an object within a "frame" or "card.")

View Control of Objects' Form, Sequence and Content — where a structured, mixed-object document may be displayed in a window according to a flexible choice of viewing options — especially by selective level clipping (outline for viewing), but also by filtering on content, by truncation or some algorithmic view that provides a more useful portrayal of structure and/or object content (including new sequences or groupings of objects that actually reside in other documents). Editing on structure or object content directly from such special views would be allowed whenever appropriate.

The Basic "Hyper" Characteristics — where embedded objects called *links* can point to any arbitrary object within the document, or within another document in a specified domain of documents — and the link can be actuated by a user or an automatic process to "go see what is at the other end," or "bring the other-end object to this location," or "execute the process identified at the other end." (These executable processes may control peripheral devices such as CD ROM, video-disk players, etc.)

Hyperdocument "Back-Link" Capability — when reading a hyperdocument online, a worker can utilize information about links from other objects within this or other hyperdocuments that point to this hyperdocument — or to designated objects or passages of interest in this hyperdocument.

Link Addresses That Are Readable and Interpretable by Humans — one of the "viewing options" for displaying/printing a link object should provide a human-readable description of the "address path" leading to the cited object; AND, the human must be able to read the path description, interpret it, and follow it (find the destination "by hand" so to speak).

Personal Signature Encryption — where a user can affix his personal signature to a document, or a specified segment within the document, using a private signature key. Users can verify that the signature is authentic and that no bit of the signed document or document segment has been altered since it was signed. Signed document segments can be copied or moved in full without interfering with later signature verification.

Hard-Copy Print Options to Show Addresses of Objects and Address Specification of Links — so that, besides online workers being able to follow a link-citation path (manually, or via an

automatic link jump), people working with associated hard copy can read and interpret the link-citation, and follow the indicated path to the cited object in the designated hard-copy document.

Also, suppose that a hard-copy worker wants to have a link to a given object established in the online file. By visual inspection of the hard copy, he should be able to determine a valid address path to that object and for instance hand-write an appropriate link specification for later online entry, or dictate it over a phone to a colleague.

Hyperdocument Mail — where an integrated, general-purpose mail service enables a hyperdocument of any size to be mailed. Any embedded links are also faithfully transmitted — and any recipient can then follow those links to their designated targets that may be in other mail items, in common-access files, or in "library" items.

The Hyperdocument "Journal System" — an integrated library-like system where a hyperdocument message or document can be submitted using a submittal form (technically an email message form), and an automated "clerk" assigns a catalog number, stores the item, notifies recipients with a link for easy retrieval, notifies of supercessions, catalogs it for future searching, and manages document collections. Access is guaranteed when referenced by its catalog number, or "jumped to" with an appropriate link. Links within newly submitted hyperdocuments can cite any passages within any of the prior documents, and the back-link service lets the online reader of a document detect and "go examine" any passage of a subsequent document that has a link citing that passage.

Access Control — Hyperdocuments in personal, group, and library files can have access restrictions down to the object level.

External Document Control (XDoc) — (Not exactly a "hyperdocument" issue, but an important system issue here.) Documents not integrated into the above online and interactive environment (e.g. hard-copy documents and other records otherwise external to the OHS) can very effectively be managed by employing the same "catalog system" as for hyperdocument libraries — with back-link service to indicate citations to these "offline" records from hyperdocument (and other) data bases. OHS users can find out what is being said about these "XDoc" records in the hyperdocument world.

The overview portrayal in Figure 11 shows the working relationships between the major system elements described above. Note the shared catalog service that supports use of the Journal and External Document services.

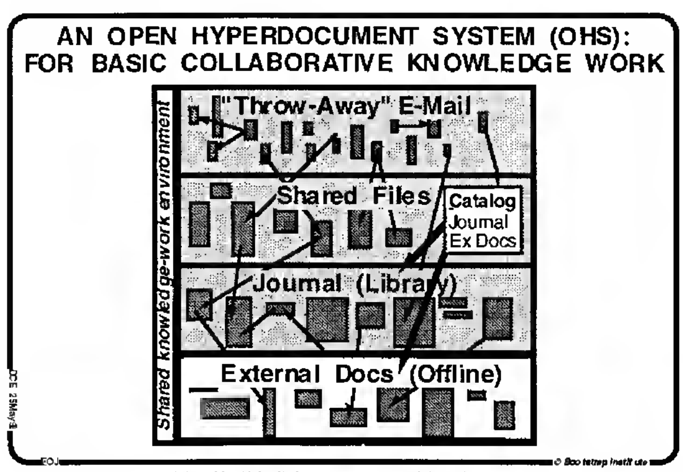

Figure 11

"Hyperdoc" provides flexible linkages to any object in any multi-media file; "Open" provides vendor-independent access within and across work groups.

Details of features and designs for well-developed prototypes of some of the above may be found in Ref-6, Ref-7 and Ref-8.

7 FOUR GENERAL GROUPWARE ARCHITECTURAL REQUIREMENTS

Besides the aforementioned Hyperdocument Mail and Hyperdocument Library features that depend upon special larger-scale architectural features, there are at least four other important tool-system capabilities that are very important to wide-area groupware services such as being considered here:

Global and Individual Vocabulary Control — somewhat new in the history of computer services are issues regarding the evolution and use of a common "workshop vocabulary" among all the users of the forthcoming "global knowledge workshop." Common data dictionaries have been at issue, of course, but for a much more limited range of users, and for a more limited and stable vocabulary than we will face in the exploding groupware world.

Our own architectural approach (see Ref-6, Ref-9 and Ref-10) has been to introduce into every user-interface environment a common Command-Language Interpreter (CLI) module that derives the user's available operations (verbs) as applied to the available classes of objects (nouns) from a grammar file (individualized if desired with respect to the size and nature of the verbs and nouns utilized from the common vocabulary). The CLI interprets user actions, based upon the contents of the currently attached grammar file, and executes appropriate actions via remote procedure calls to a common application program interface of the "open system environment."

Each of us knowledge workers will become involved in an ever richer online environment, collaborating more and more closely within an ever more global "knowledge workshop," with multi-organizational users of widely divergent skills and application orientations who are using hardware and software from a wide mix of vendors.

Without some global architectural capability such as suggested above, I can't see a practical way to support and control the evolving global "workshop vocabulary" in a manner necessary for effectively integrating wide-area groupware services.

Multiplicity of Look-and-Feel Interface Choices — Based upon the same Command-Language Interpreter (CLI) architecture as above, a "look-and-feel interface" software module would be located between the CLI and the window system. Providing optional modules for selected look-and-feel interface characteristics would serve an important practical as well as evolutionary need.

There would be a basic constraint necessary here. When working interactively, no matter what particular look-and-feel style is being used, a user has a particular mental model in mind for the significance of every menu item, icon, typed command, or "hot, command-key combination" employed.

The necessary constraint needed here is that the resulting action, via the interface module that is being employed for this user, must be produced through the underlying execution of processes provided by the Command Language Interpreter module as derived from use of common-vocabulary terms. And the users should learn about their tools and materials, and do their discussing with others about their work, using the underlying common-vocabulary terms no matter what form of user interface they employ.

Besides relaxing the troublesome need to make people conform to a standard look and feel, this approach has a very positive potential outcome. So far, the evolution of popular graphical user interfaces has been heavily affected by the "easy to use" dictum. This has served well to facilitate wide acceptance, but it is quite unlikely that the road to truly high performance can effectively be traveled by people who are stuck with vehicular controls designed to be easy to use by a past generation.

As important classes of users develop larger and larger workshop vocabularies, and exercise greater process skill in employing them, they will undoubtedly begin to benefit from significant changes in look and feel. The above approach will provide open opportunity for that important aspect of our evolution toward truly high performance.

Shared-Window Teleconferencing — where remote distributed workers can each execute a related support service that provides the "viewing" workers with a complete dynamic image of the "showing" worker's window(s). Used in conjunction with a phone call (or conference call), the parties can work as if they are sitting side-by-side, to review, draft, or modify a document, provide coaching or consulting, support meetings, and so on. Control of the application program (residing in the "showing" worker's environment) can be passed around freely among the participants. Generic provision of this service is discussed in Ref-6.

Inter-Linkage Between Hyperdocuments and Other Data Systems — for instance, a CAD system's data base can have links from annotations/comments associated with a design object that point to relevant specifications, requirements, arguments, etc. of relevance in a hyperdocument data base — and the back-link service would show hyperdocument readers which passages were cited from the CAD data base (or specified parts thereof).

Similarly, links in the hyperdocuments may point to objects within the CAD bases. And, during later study of some object within the CAD model, the back-link service could inform the CAD worker as to which hyperdocument passages cited that object.

8 THE CODIAK PROCESS SUPPORTED BY AN OHS

With the above tool capabilities, together with well-developed methods and other human-system elements as discussed in section 1.2, the organization's capability infrastructure could support the following types of online CODIAK scenarios.

Note that the following online interactions are designed to work even if the users are in different organizational units, in different organizations, using different application packages on different workstations (assuming access to the data is not barred by the stringent privacy features, naturally). The real test of an OHS is when you can click on a link you received via email from someone in a different organization, jumping directly to the passages cited, and then comfortably maneuver through the "foreign" knowledge domain, possibly jumping up a level with an outline view to see the context of the given passage, following other links you find there, and so on, *without having to fumble through unfamiliar processes.*

Intelligence Collection: Now an alert project group, whether classified as an A, B, or C Activity, can keep a much enhanced watchful eye on its external environment, actively surveying, ingesting, and interacting with it mostly online. Much of the external intelligence is now available in hyperdocument, multimedia form, having been captured in an OHS Journal facility. When I send you an email to let you know about an upcoming conference, I can cite the sessions I think you'd be interested in, and you can click on the enclosed citation links to quickly access the cited passages (taking advantage of hypertext links and object addressability). When I do a search through the Journal catalogs to research

a question for the proposal I am writing, I can see who has cited the material and what they had to say about it. If the material is offline (i.e. in XDoc), I can quickly discover where it is stored and how to obtain a copy, probably requesting it via email. If the material is online, I can access it instantly, usually starting with a top-level outline view of the document's titles (taking advantage of the OHS document structure and custom viewing features), possibly setting a simple filter to narrow the field, then quickly zooming in on the specific information I require. I can quickly build an annotated index to the intelligence documents, or objects within those documents, that I want to keep track of. I can share with you a macro I wrote to trap certain incoming intelligence items and reformat them in a certain way, and you could fire this up in your own environment to work off your pet keywords (taking advantage of the common-vocabulary architectural feature). All the intelligence collected is easily integrated with other project knowledge.

Dialog Records: Responding effectively to needs and opportunities involves a high degree of coordination and *dialog* within and across project groups. In an OHS environment, most of the dialog will be conducted online via the Journal. Email would be used mostly for "throw-away" communiqués, such as meeting reminders. All memos, status reports, meeting minutes, design change requests, field support logs, bug reports, and so on, would be submitted to the Journal for distribution. Asynchronous online conferencing would be supported by the Journal, with each entry tagged and cataloged for easy future reference. Document exchange would be a matter of submitting the document to the Journal with a comment such as "Here's the latest version — please note especially the changes in Section G, differences are listed in File Y" including links to that section and that file for easy access. The reviewers would click on the links, and proceed to review the document. To make a comment, the reviewer would click on the object in question, and enter the comment, such as "Replace with 'Xyz'," or "Watch out for inconsistencies with Para G4!" with a link to the passage in G4. The author then gets back the indexed comments, and has many options for quickly reviewing and integrating them into the document. Such dialog support will obviate the need for many same-time meetings.

Same-time meetings, when needed, would be greatly enhanced by an OHS. The dialog motivating the meeting would already be in the Journal. Agenda items would be solicited, and the agenda distributed via the Journal. At the meeting, the agenda and real-time group notes can be projected on a large screen, as well as displayed on each participant's monitor (using the "shared screen" feature), and any participant can point to the displayed material (e.g. using a mouse). Controls can be passed to any participant to scribble, type, or draw on this virtual chalkboard. Any presentation materials and supporting documents can be instantly retrieved from the knowledge base for presentation. All resulting meeting documents, along with references to supporting documents cited, would subsequently be submitted to the Journal for immediate access by all authorized users.

In addition, tools will soon become generally available for flexibly contributing, integrating, and interlinking digitized speech into the OHS knowledge base. Early tools would be available for speaker recognition, for special-word recognition, and even for basic transcription to text — and for installing and following links between modules as small as a word embedded in a long speech string. This will greatly enhance the development, integration, and application of dialog records. More elegant tools will follow, and as human conventions and methods evolve to make effective use of the technology, the quantity and completeness of recorded dialog will become much more significant.

Knowledge Product: Throughout the life cycle of the project, the online OHS knowledge product will provide a truly comprehensive picture of the project at hand. Intermediate project states, including supporting intelligence and dialog trails, can be bundled as document collections in the Journal for document version management. All knowledge

products will be developed, integrated, and applied within an OHS, with concurrent contributions from many diverse and widely distributed users. These users can also work as if sitting side by side, reviewing a design, marking up a document, finalizing the changes, etc. (using the shared screen feature). Finding what you need among the thousands of project documents will be a simple matter of clicking on a link (provided by the Journal catalogs, or by your project's indices), and zooming in and out of the detail, or by having someone else "take you there" (using the shared screen feature). Accountability is absolute— Journal submittals are guaranteed to be authentic, and each object can be tagged by the system with the date and time of the last write, plus the user who made the change. Documents can be signed with verifiable signatures.

Everyone is but one quick "link hop" away from any piece of knowledge representation anywhere in the whole knowledge collection. Smart retrieval tools can rapidly comb part or all of the collection to provide lists of "hit links" with rated relevance probabilities.

Conventions for structuring, categorizing, labeling and linking within their common knowledge domain will be well established and supportive of a high degree of mobility and navigational flexibility to experienced participants — much as residents get to know their way effectively around their city if they get much practice at it.

As a group adapts its ways of working to take better advantage of a tool system such as projected here, the classes of knowledge objects will grow, as will the functions available to operate upon them—and that growth will be paralleled by the concurrent evolution of an ever richer repertoire of the humans' "workshop knowledge, vocabulary, methodology and skills."

There is tremendous potential here, and many methods, procedures, conventions, organizational roles to be developed in close association with the tools. And, if the OHS is to be *open*, there is much deep exploration to be done into different application domains, such as Computer-Supported Cooperative Work (CSCW), organizational learning, Total Quality Management (TQM), Enterprise Integration (EI), program management, Computer-Aided Software Engineering (CASE), Computer-Aided Engineering (CAE), Concurrent Engineering (CE), organizational memory, online document delivery and CALS, and so on. This will require many advanced pilots, as will be discussed further on.

9 RECAP: THE FRAMEWORK TO THIS POINT

To this point in the paper, we have outlined steps in the development of a strategy to provide a high-leverage approach toward creating truly high-performance organizations.

We considered the concept of the organization's *capability infrastructure* upon which any of the organization's effectiveness must depend.

Further, what enables humans to exercise this infrastructure of capabilities is an *Augmentation System*, which is what provides the humans with all capabilities beyond their genetically endowed basic mental, motor and perceptual capabilities. It was useful to divide the Augmentation System into two sub-systems, the Human System and the Tool System. "Organic style co-evolution" among the elements of our Augmentation System has been the process by which it evolved to its current state.

New technologies are introducing an unprecedented scale of improvement in the Tool System part of the Augmentation System. This promises that subsequent co-evolution of our Augmentation Systems will likely produce radical qualitative changes in the form and functional effectiveness of our capability infrastructures, and hence of our organizations.

Very large and challenging problems are envisioned in pursuing potential benefits of such changes, towards truly high-performance organizations. A strategy is sought to provide an effective approach.

It would be profitable to consider early focus on improving the organizational improvement process so that further improvements can be done more effectively.

To help with this analysis, the *ABC* categorization of improvement-process was established. And the thesis was developed that the *CODIAK* set of knowledge capabilities — the concurrent development, integration, and application of knowledge — is important to all three types of activities. Therefore, if CODIAK improvement was concentrated upon early, the result could improve the first and second derivatives of the return on future improvement investments.

An Open Hyperdocument System (*OHS*) would be a key "Tool System" development towards improving general and widespread CODIAK capabilities within and between organizations. And creating a truly effective OHS would in itself be an extremely challenging and global problem for our groupware marketplace.

So, high-performance organizations: great opportunities, interesting concepts, tough challenges. What next regarding strategy?

10 C COMMUNITY: HIGH-PAYOFF BOOTSTRAPPING OPPORTUNITY

Returning to the basic ABC Model in Figure 4, we can make a few useful observations toward a next step in strategy development. This model will be useful even if the Bootstrapping approach is not followed; it is valuable to become explicit about differentiating responsibilities, functions and budgets between the two levels of improvement activity (B and C).

If explicit C roles are designated and assumed, basic issues will soon arise for which the C-Activity leaders find it valuable to compare experiences and basic approaches with their counterparts in other organizations. For instance, what budgeting guidelines and targets make sense for these improvement activities? How much can it help the B Activity to document the way things are done now? What role should pilot applications play? How large an improvement increment, for how big a group, does it make sense to try for a pilot? How much "instrumentation" of a pilot group — before, during, and after transition — to measure the value of the effort? These are all relevant to making the B Activity more effective.

So let us consider formalizing and extending the above type of cooperation among improvement activities, especially the C Activities. In the mid-60s I began to think about the nature and value of communities of common interest formed among different improvement activities. This led me very early to build explicit planning into the bootstrap strategy for forming improvement communities.

In Ref-11 (1972), I presented the concept of a "community knowledge workshop" -- outlining the tools we had developed for supporting it (including many of the hyperdocument system capabilities outline above), and described the three basic CODIAK sub-domains: recorded dialog, intelligence collection, and what I then called the "handbook" (or knowledge products).

After the ABC Model emerged in the framework, this evolved into a special emphasis on an important launching phase, for forming one or more special bootstrapping *C Communities* as shown in Figure 12.

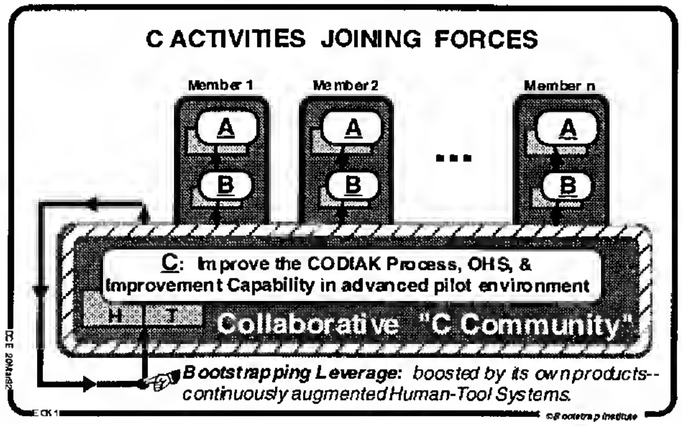

Figure 12

The value of such a cooperative activity can be very high — we'll unveil some of that later. First, there are some other questions that naturally arise which need to be addressed. An early and common pair of comments are: "I can't imagine sharing things with my competitors, there is so much about what we do that is proprietary;" and, "If they aren't in the same business, I don't see what useful things there would be that we could share."

About proprietary matters: The A Activity of each organization may be very competitive, with considerable proprietary content. The B Activity of each would tend to be less so — having quite a bit that is basic and generic. The C Activity of each would be much less involved in proprietary issues, and much more in basic, generic matters. So even competitors could consider cooperating, "out of their back doors" — "while competing like hell out of our front doors," as a trend that seems to be appearing among companies heavily into Total Quality Management and pursuit of the Malcolm Baldridge Award.

About being in very different business: Again, their B Activities will be much less different, and their C Activities surprisingly alike in important basic and generic issues.

Now, consider how a C Community could operate if it had the basic hyperdocument tools described above. For several decades, my colleagues and I have had such a system available, so all of our scenarios began there, using that system and calling it our "OHS, Model 1" — or "OHS-1."

And how would an ideal bootstrapping C Community operate? Its earliest focus would be on augmenting its own CODIAK capability. Using OHS-1 to do its work; making an important part of its work at first be to establish requirements, specifications and a procurement approach for getting a set of rapidly evolving prototype hyperdocument systems (e.g. OHS-2, -3, etc.), to provide ever better support for serious pilot applications among the C Community participants.

The Community's basic knowledge products could be viewed as dynamic electronic handbooks on "how to be better at your improvement tasks," with two customer groups: its B-Activity customers; and the C Community itself. Pooling resources from the member organizations enables a more advanced and rapidly evolving prototype CODIAK environment, which serves two very important purposes:

1. It provides for the Community getting better and better at its basic "C Activity;"

2. It provides advanced experience for its rotating staff of participants from the member organizations. They thus develop real understanding about the real issues

involved in boosting CODIAK capability — this understanding being absorbed by "living out there in a real, hard-working CODIAK frontier."

Note that it would be much more expensive for each member organization to provide equivalent experience by operating its own advanced pilot. Also the amount of substantive knowledge product developed this way would be very much more expensive if developed privately.

An important feature: once the Community stabilizes with effective groupware tools, methods and operating skills, the participants from the respective member organizations can do most of their work from their home-organization sites. This provides for maintaining the organizational bonding which is very important in effective C and B activities.

This home-site residency also facilitates the all-important "technology transfer" from the C Community into its customer B Activities. And, while considering the issue of "technology transfer," note that a strong feature of an augmented CODIAK process is the two-way transfer of knowledge. Developing dialog with the B clients via joint use of the hyperdocument system not only facilitates directly this two-way knowledge transfer, but provides critically important experience for the B people in the close witnessing of how advanced CODIAK processes work.

To characterize the value of facilitating this two-way transfer, consider Figure 13, which highlights the basic importance of improved CODIAK processes in the organization's improvement activity. The "1, 2, 3" points all are basic to the CODIAK process. As augmented CODIAK capabilities make their way up from C to B and into A, the over-all improvement process can't help but improve. And also, note that when the A Activity for this organization, as well as those for its customers, become based on interoperable CODIAK processes, the dynamics of the whole business will begin to sparkle.

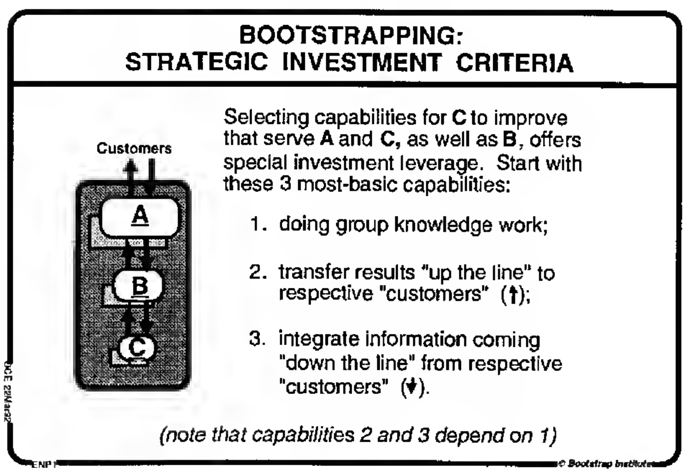

Figure 13

Now consider Figure 14, and note that the indicated types of knowledge flow are basic to the CODIAK processes, and that augmenting those processes for the C Community directly boosts one of its core capabilities. Conversely, Figure 15 emphasizes the previous basic point of the naturalness for enhanced CODIAK to improve this outflow, and highlights again the basic bootstrapping value that is obtained from early focus on these CODIAK processes.

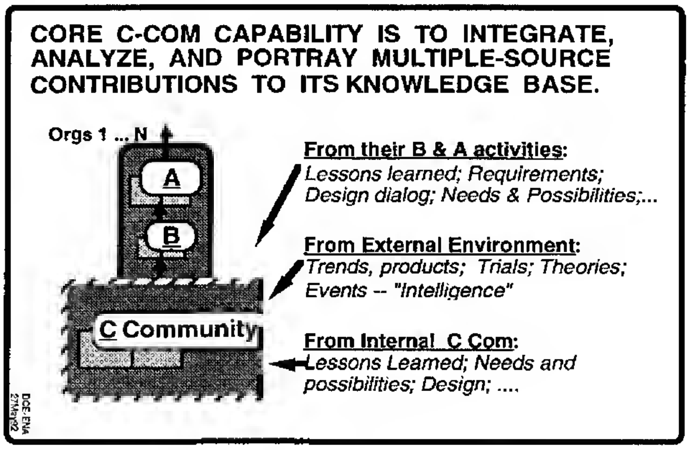

Figure 14

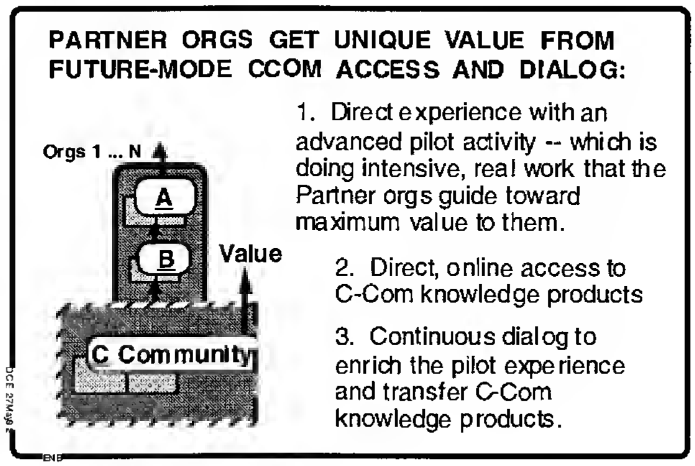

Figure 15

In the organizational improvement domain, there are several immediately apparent large and explicit issues for which a lone organization would need to consider a multi-party alliance. An immediate such issue, from the bootstrapping point of view, is to procure appropriate groupware systems that can support advanced pilot applications. Other large-sized issues have to do with "exploration and outpost settlements."

Relative to the options opening to our organizations for transforming into new states, there is a very large, unexplored, multi-dimensioned frontier out there. Both its dimensionality and its outer boundaries are expanding faster and faster. To really learn about that frontier, in order to decide where we would want to "settle our organizations," we must somehow do a great deal of basic exploration work. We also need to establish a significant number of outpost settlements in promising places so as to find out ahead of time what it would be like to really live and work there. (Translate "outposts" into "advanced pilot groups.")

Yet we are launching very few exploratory expeditions and developing very few significant outposts.

From the viewpoint that I have acquired, there is a great need for such explorations and trial settlements. Much of my motivation for advocating such as C Communities, bootstrapping, CODIAK and OHS pursuits, etc., is to find a strategy for exploring and settling that territory. It is almost like a military strategy: "first we get a firm settlement here in

CODIAK territory; then with that as a base, we encircle the OHS and C territories; when we get those under reasonable control, we will be in a most advantageous posture to pour through the rest of the B and C Improvement Territories to get the whole area under control and ..."

As the C Community and its working relationship with its "B customer" matures, there can be integrated into the substance of their joint efforts an ever larger sphere of involvement with the whole set of issues of organizational improvement.

Potential customers for augmented CODIAK capabilities can be seen everywhere in today's global society: e.g., all of the "Grand Challenges" earmarked in the U.S. for special support. Essentially every professional society will eventually operate this way; as will legislative bodies and government agencies, and university research programs.

In short, our solutions to every other challenging problem that is critical to our society will become significantly facilitated by high-performance CODIAK capabilities. Provides a stimulating challenge for the groupware community, doesn't it?

In closing, I would like to re-emphasize the comments in Section 1.4 about paradigms. I am convinced that cultivating the appropriate paradigm about how to view and approach the future will in the pursuit of high-performance organizations be the single most critical success factor of all.

[Note: The Bootstrap Institute has developed basic plans for several scales of C-Community launching — a medium-sized consortium approach on the one hand, and a more conservative, organic evolution approach on the other hand. Interested inquiries are invited.]

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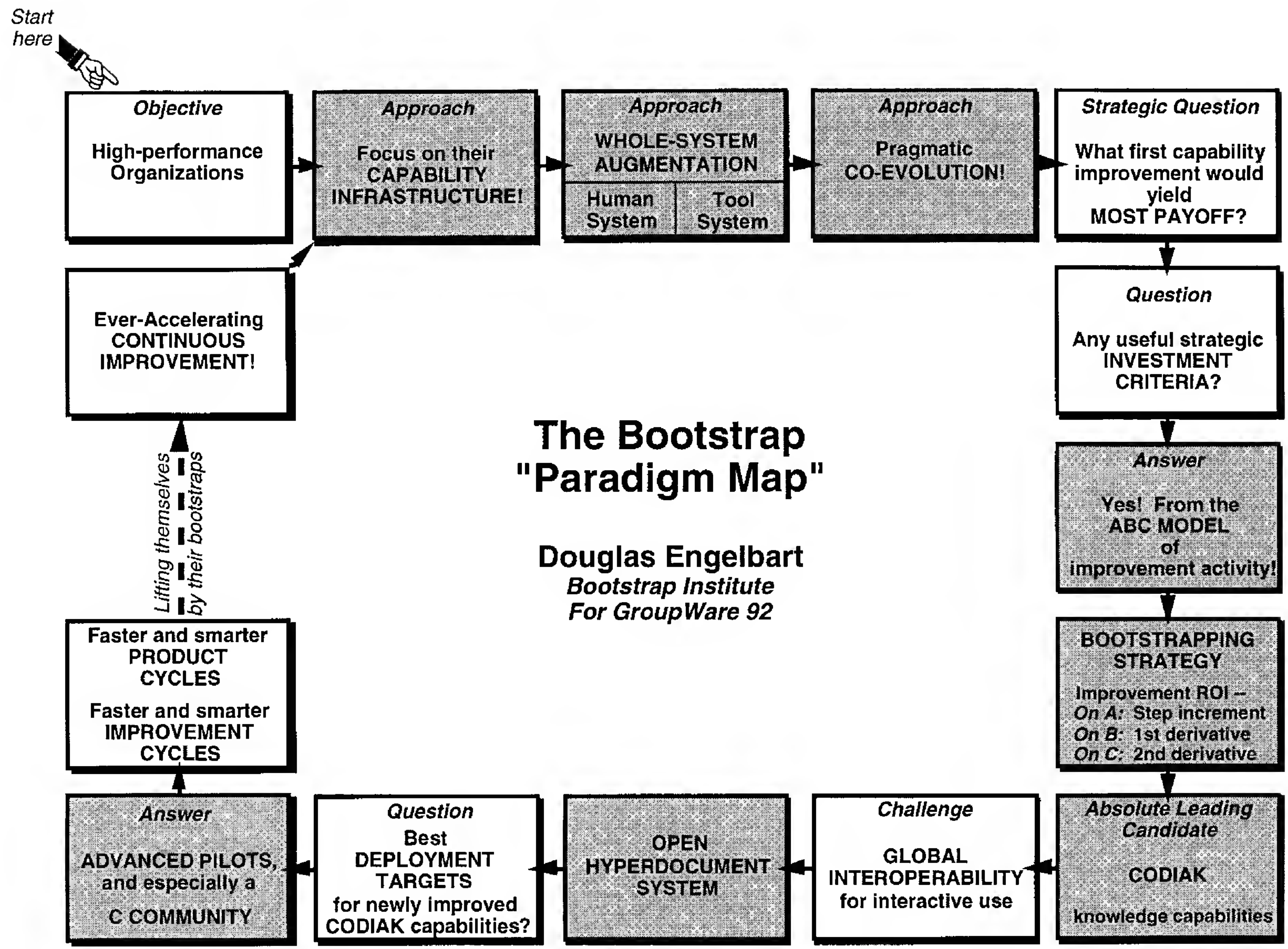

Start here
Objective
High-performance Organizations
Approach
Focus on their CAPABILITY INFRASTRUCTURE!
Approach
WHOLE-SYSTEM AUGMENTATION
Human System
Tool System
Approach
Pragmatic CO-EVOLUTION!
Strategic Question
What first capability improvement would yield MOST PAYOFF?
Question
Any useful strategic INVESTMENT CRITERIA?
Answer
Yes! From the ABC MODEL of improvement activity!
BOOTSTRAPPING STRATEGY
Improvement ROI --
On A: Step increment
On B: 1st derivative
On C: 2nd derivative
Absolute Leading Candidate
CODIAK
knowledge capabilities
Challenge
GLOBAL INTEROPERABILITY for interactive use
OPEN HYPERDOCUMENT SYSTEM
Question
Best DEPLOYMENT TARGETS for newly improved CODIAK capabilities?
Answer
ADVANCED PILOTS, and especially a C COMMUNITY
Faster and smarter PRODUCT CYCLES
Faster and smarter IMPROVEMENT CYCLES
Lifting themselves by their bootstraps
Ever-Accelerating CONTINUOUS IMPROVEMENT!
The Bootstrap "Paradigm Map"
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Bootstrap Institute
For GroupWare 92